Allen-Bradley

# ControlLogix Analog I/O Modules

**1756-IF16,- IF6CIS, -IF6I, -IF8, -IR6I, -IT6I, -IT6I2, -OF4, -OF6CI, -OF6VI, -OF8**

**User Manual**

Rockwell Automation

## Important User Information

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## Introduction

This release of this document contains updated information. Changes are designated by change bars in margin, as shown.

## New and Revised Information

Table Summary of Changes.1 lists the new and revised information included in this release of the ControlLogix digital I/O modules user manual.

**Table Summary of Changes.1 New and Revised Information**

| In this section: | This information changed or was added: |
|---|---|
| Chapter 2 | Triggering Event Tasks |
| Chapter 3 | • Electronic Keying<br>• 1756-IF6I module count information in integer mode |
| Module-specific chapters (i.e. Chapter 4 through Chapter 8) | Module block diagrams and input/output circuit diagrams |
| Chapter 5 | Full description of ControlLogix Sourcing Current Loop Input Module (1756-IF6CIS) |
| Chapter 6 | • Full description of ControlLogix Thermocouple Input Module (1756-IT6I2)<br>• Wire Off Detection with the 1756-IR6I module |
| Appendix A | • Specifications for 1756-IF6CIS module<br>• Specifications for 1756-IT6I2 module<br>• Updated Open Circuit Detection specification for the 1756-IR6I module |
| Appendix C | Differences when using message instructions in RSLogix 5000, v 9 or earlier versus using RSLogix 5000, v10 or greater. |
| Appendix E | Additional specification information |
| Glossary | After Appendix C |

Other changes have been made throughout this manual and, although not significant enough to warrant mention in the table above, they are marked by change bars.

## Notes:

# About This User Manual

## What This Preface Contains

This preface describes how to use this manual. The following table describes what this preface contains and its location.


| For information about: | See page: |
|---|---|
| Who Should Use This Manual | Preface-1 |
| Purpose of This Manual | Preface-1 |
| Related Products and Documentation | Preface-3 |


## Who Should Use This Manual

You must be able to program and operate a Rockwell Automation ControlLogix controller to efficiently use your analog I/O modules.

We assume that you know how to do this in this manual. If you do not, refer to the Logix5000 Controller documentation before you attempt to use this module. Table Preface.2 lists related documentation.

## Purpose of This Manual

This manual describes how to install, configure, and troubleshoot your ControlLogix analog I/O module.

## What This Manual Contains

Table Preface.1 lists describes the sections contained in this manual.

**Table Preface.1**

| Section: | Title: | Description: |
|---|---|---|
| Chapter 1 | What Are ControlLogix Analog I/O Modules? | A general overview of the ControlLogix analog I/O modules and how they are used |
| Chapter 2 | Analog I/O Operation Within the ControlLogix System | Description of how ControlLogix analog I/O modules work with in a ControlLogix system |
| Chapter 3 | Using ControlLogix Analog I/O Module Features | Listing of the features that are common to all ControlLogix analog I/O modules |
| Chapter 4 | Non-Isolated Analog Voltage/Current Input Modules (1756-IF16, -IF8) | Listing of the features that are specific to the 1756-IF16 and 1756-IF8 modules |
| Chapter 5 | Sourcing Current Loop Input Module (1756-IF6CIS) and Isolated Analog Voltage/Current Input Module (1756-IF6I) | Listing of the features that are specific to the 1756-IF6CIS and 1756-IF6I modules |
| Chapter 6 | Temperature Measuring Analog Modules (1756-IR6I, 1756-IT6I & 1756-IT6I2) | Listing of the features that are specific to the 1756-IR6I and 1756-IT6I modules |
| Chapter 7 | Non-Isolated Analog Output Modules (1756-OF4 & 1756-OF8) | Listing of the features that are specific to the 1756-OF8 and 1756-OF8 modules. |
| Chapter 8 | Isolated Analog Output Modules (1756-OF6CI & 1756-OF6VI) | Listing of the features that are specific to the 1756-OF6CI and 1756-OF6VI modules |
| Chapter 9 | Installing ControlLogix I/O Modules | Step-by-step description of how to install and wire ControlLogix analog I/O modules |
| Chapter 10 | Configuring ControlLogix Analog I/O Modules | Description of how to configure ControlLogix analog I/O modules with RSLogix 5000™ |
| Chapter 11 | Calibrating the ControlLogix Analog I/O Modules | Description of how to calibrate ControlLogix analog I/O modules with RSLogix 5000 |
| Chapter 12 | Troubleshooting Your ControlLogix Analog I/O Module | Description of how to use LED status indicators and RSLogix 5000 to troubleshoot any problems with your ControlLogix analog I/O modules |
| Appendix A | Specifications | Listing of all modules' specifications |
| Appendix B | Tag Definitions | Description of how to use the RSLogix 5000 tag editor to change a module's configuration |
| Appendix C | Using Ladder Logic To Perform Run Time Services and Reconfiguration | Description of uses for ladder logic in your ControlLogix analog I/O module applications |
| Appendix D | Power Supply Sizing Chart | Information necessary to check the power your ControlLogix chassis is using. |

## Related Products and Documentation

The following table lists related ControlLogix products and documentation:

**Table Preface.2**
**Related Documentation**

| Catalog number: | Document title: | Publication number: |
|---|---|---|
| 1756-A4, -A7, -A10, -A13 | ControlLogix Chassis Installation Instructions | 1756-IN080 |
| 1756-PA72/B, -PB72/B | ControlLogix Power Supply Installation Instructions | 1756-5.67 |
| 1756-PA75, -PB75 | ControlLogix Power Supply Installation Instructions | 1756-5.78 |
| 1756-Series | ControlLogix Module Installation Instructions (Each module has separate installation document.) | Multiple 1756-IN numbers |
| 1756-Series | ControlLogix Digital I/O Modules User Manual | 1756-UM058 |
| 1756-CNB, -CNBR | ControlLogix ControlNet Interface Module User Manual | 1756-6.5.3 |
| 1756-DNB | ControlLogix DeviceNet Interface Module User Manual | 1756-6.5.19 |
| 1756-DHRIO | ControlLogix Data Highway Plus Communication Interface Module User Manual | 1756-UM514 |
| 1756-ENET | ControlLogix Ethernet Communication Interface Module User Manual | 1756-UM051 |
| 1756-ENBT | ControlLogix EtherNet/IP Bridge Module User Manual | 1756-UM050 |
| 1756-IF4FXOF2F | ControlLogix High Speed Analog I/O Module User Manual | 1756-UM005 |
| 1756-Lx | ControlLogix Selection Guide | 1756-SG001 |
| 1756-Lx | ControlLogix System User Manual | 1756-UM001 |
| 1756-Lx, 1769-Lx, 1789-Lx, 1794-Lx, PowerFlex 700S | Logix5000 Controllers Quick Reference | 1756-QR107 |
| 1756-Lx, 1769-Lx, 1789-Lx, 1794-Lx, PowerFlex 700S | Logix5000 Controllers Common Procedures Programming Manual | 1756-PM001 |
| 1756-Lx, 1769-Lx, 1789-Lx, 1794-Lx, PowerFlex 700S | Logix5000 Controllers Motion Instruction Set Reference Manual | 1756-RM007 |
| 1756-Lx, 1769-Lx, 1789-Lx, 1794-Lx, PowerFlex 700S | Logix5000 Controllers General Instructions Reference Manual | 1756-RM003 |
| Allen-Bradly I/O catalog numbers | I/O Products System Overview | CIG-SO001 |

For more information on these products, contact your local Rockwell Automation distributor or sales office.

The documentation listed in Table Preface.2 is available at the following locations:

- http://www.ab.com/manuals/cl
- http://www.theautomationbookstore.com

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**Appendix F**

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**Glossary**

**Index**

# What Are ControlLogix Analog I/O Modules?

## What This Chapter Contains

This chapter describes the ControlLogix analog modules and what you must know and do before you begin to use them.


| For information about: | See page: |
|---|---|
| What are ControlLogix Analog I/O Modules? | 1-1 |
| Using an I/O Module in the ControlLogix System | 1-3 |
| Features of the ControlLogix Analog I/O Modules | 1-4 |
| Using Module Identification and Status Information | 1-5 |
| Preventing Electrostatic Discharge | 1-6 |
| Removal and Insertion Under Power | 1-6 |


## What are ControlLogix Analog I/O Modules?

ControlLogix analog I/O modules are interface modules that convert analog signals to digital values for inputs and convert digital values to analog signals for outputs. Controllers can then use these signals for control purposes.

Using the producer/consumer network model, ControlLogix analog I/O modules produce information when needed while providing additional system functions.

Table 1.1 lists the features available on ControlLogix analog I/O modules that allow greater system applicability.

**Table 1.1 ControlLogix Analog I/O Module Features**

| Feature: | Description: |
|---|---|
| Removal and insertion under power (RIUP) | This system feature allows you to remove and insert modules and RTB while power is applied. For more information on RIUP, see page 1-6. |
| Producer/consumer communications model | These communications are an intelligent data exchange between modules and other system devices in which each module produces data without having been polled. |
| Rolling timestamp of data | 15-bit module-specific rolling timestamp with millisecond resolution which indicates when data was sampled/applied. This timestamp may be used to calculate the interval between channel or field side updates |
| Multiple data formats | Analog I/O modules offer the option of IEEE 32-bit floating point or 16-bit integer data formats. |
| Module resolution | Analog input modules use 16-bit resolution, and analog output modules offer 13 to 16-bit output resolution, depending on the module type, to detect data changes. |
| On-board features | Features such as scaling to engineering units, alarming and under/overrange detection increase the modules' complexity and effectiveness. |
| Calibration | ControlLogix analog I/O module ships from the factory with factory calibration. You can recalibrate the module calibration on a channel-by-channel or module-wide basis to increase accuracy in customer-specific applications, if necessary. |
| Coordinated System Time (CST) timestamp of data | 64-bit system clock (i.e. Coordinated System Time [CST]) places a timestamp on the transfer of data between the module and its owner-controller within the local chassis |
| UL, CSA, FM, CE, C-Tick, EEx, TUV Agency Certification | Full agency certification for in any application that requires approval of the agencies listed.<br><br>Agency certification varies depending on catalog number. To see a complete listing of the certifications associated with each catalog number, see Appendix A. |

## Using an I/O Module in the ControlLogix System

ControlLogix modules mount in a ControlLogix chassis and use a Removable Terminal Block (RTB) or a Bulletin 1492 Interface Module[1] cable that connects to an IFM to connect all field-side wiring. Before you install and use your module you should have already:

- installed and grounded a 1756 chassis and power supply[2]. To install these products, refer to the publications listed in Table Preface.2 on page Preface-3.
- ordered and received an RTB or IFM and its components for your application.

**IMPORTANT** RTBs and IFMs are not included with your module purchase.

**Table 1.2 Types of ControlLogix Analog I/O**

| Catalog Number: | Description: | RTB Used: | Module Specific Information in Section: |
|---|---|---|---|
| 1756-IF16 | 16-point non-isolated analog current/voltage input module | 36 pin | Chapter 4 |
| 1756-IF8 | 8-point non-isolated analog current/voltage input module | 36 pin | |
| 1756-IF6CIS | 6-point sourcing current loop input module | 20 pin | Chapter 5 |
| 1756-IF6I | 6-point isolated analog current/voltage input module | 20 pin | |
| 1756-IR6I | 6-point isolated RTD input module | 20 pin | Chapter 6 |
| 1756-IT6I | 6-point isolated Thermocouple/mV input module | 20 pin | |
| 1756-IT6I2 | 6-point isolated Enhanced Thermocouple/mV input module | 20 pin | |
| 1756-OF4 | 4-point non-isolated analog current/voltage output module | 20 pin | Chapter 7 |
| 1756-OF8 | 8-point non-isolated analog current/voltage output module | 20 pin | |
| 1756-OF6CI | 6-point isolated analog current output module | 20 pin | Chapter 8 |
| 1756-OF6VI | 6-point isolated analog voltage output module | 20 pin | |

(1) The Bulletin 1492 IFM may not be used in any application that requires agency certification of the ControlLogix system. Use of the IFM violates the UL, CSA and FM certifications of a ControlLogix digital I/O module. Also, to see what IFMs are used with each ControlLogix analog I/O module, see Appendix F.

(2) In addition to standard ControlLogix power supplies, ControlLogix Redundant Power Supplies are also available for your application. For more information on these supplies see the ControlLogix Selection Guide, publication 1756-SG001 or contact your local Rockwell Automation distributor or sales representative.

## Features of the ControlLogix Analog I/O Modules

**Figure 1.1**

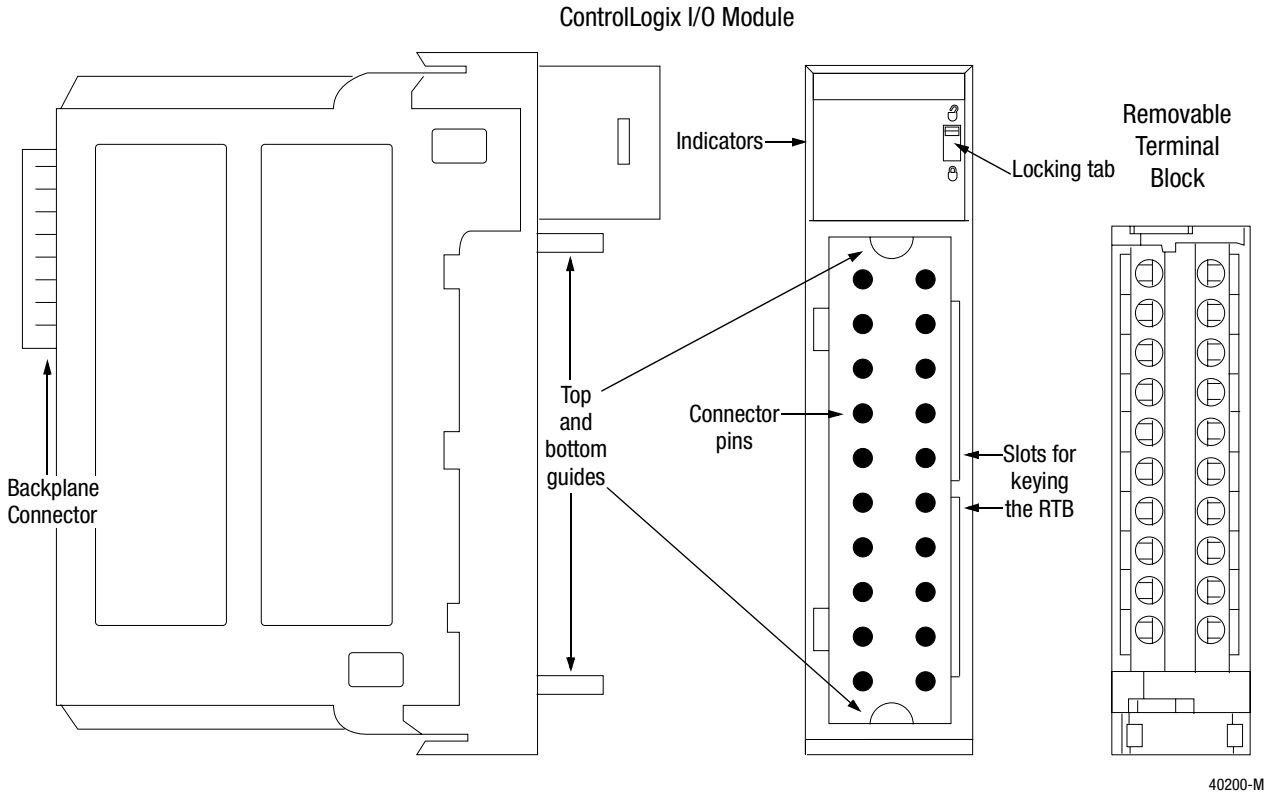



Table 1.3 lists descriptions of the physical features shown in Figure 1.1.

**Table 1.3 Physical Features on the ControlLogix Digital I/O Modules**

| Physical Feature: | Description: |
|---|---|
| Backplane connector | The backplane connector interface for the ControlLogix system connects the module to the ControlBus backplane. |
| Connector pins | Input/output, power and grounding connections are made to the module through these pins with the use of an RTB or IFM. |
| Locking tab | The locking tab anchors the RTB or IFM cable on the module, maintaining wiring connections. |
| Slots for keying | Mechanically keys the RTB to prevent inadvertently making the wrong wire connections to your module. |
| Status indicators | Indicators display the status of communication, module health and input/output devices. Use these indicators to help in troubleshooting. |
| Top and bottom guides | Guides provide assistance in seating the RTB or IFM cable onto the module. |

## Using Module Identification and Status Information

Each ControlLogix I/O module maintains specific identification information that separates it from all other modules. This information assists you in tracking all the components of your system.

For example, you can track module identification information to be aware of exactly what modules are located in any ControlLogix rack at any time. While retrieving module identity, you can also retrieve the module's status.

Each module maintains the following information:

**Table 1.4 Module Identification and Status Information**

| Module Identification: | Description: |
|---|---|
| Product Type | Module's product type, such as Digital I/O or Analog I/O module |
| Catalog Code | Module's catalog number |
| Major Revision | Module's major revision number |
| Minor Revision | Module's minor revision number |
| Status | Module's status. Returns the following information:<br>• Controller ownership (if any)<br>• Whether module has been configured<br>• Device Specific Status, such as:<br>  • Self-Test<br>  • Flash update in progress<br>  • Communications fault<br>  • Not owned (outputs in program mode)<br>  • Internal fault (need flash update)<br>  • Run mode<br>  • Program mode (output mods only)<br>• Minor recoverable fault<br>• Minor unrecoverable fault<br>• Major recoverable fault<br>• Major unrecoverable fault |
| Vendor ID | Module manufacturer vendor, for example Allen-Bradley |
| Serial Number | Module serial number |
| Length of ASCII Text String | Number of characters in module's text string |
| ASCII Text String | Number of characters in module's text string |

**IMPORTANT** You must perform a WHO service to retrieve this information.

## Preventing Electrostatic Discharge

This module is sensitive to electrostatic discharge.

**ATTENTION**

This equipment is sensitive to electrostatic discharge, which can cause internal damage and affect normal operation. Follow these guidelines when you handle this equipment:

- Touch a grounded object to discharge potential static.
- Wear an approved grounding wriststrap.
- Do not touch connectors or pins on component boards.
- Do not touch circuit components inside the equipment.
- If available, use a static-safe workstation.
- When not in use, store the equipment in appropriate static-safe packaging.

## Removal and Insertion Under Power

These modules are designed to be installed or removed while chassis power is applied.

**WARNING**

When you insert or remove the module while backplane power is on, an electrical arc can occur. This could cause an explosion in hazardous location installations.

Be sure that power is removed or the area is nonhazardous before proceeding. Repeated electrical arcing causes excessive wear to contacts on both the module and its mating connector. Worn contacts may create electrical resistance that can affect module operation.

## Chapter Summary and What's Next

In this chapter you read about what ControlLogix analog I/O modules are. Chapter 2 describes Analog I/O Operation Within the ControlLogix System.

# Analog I/O Operation Within the ControlLogix System

## What This Chapter Contains

This chapter describes how analog I/O modules work within the ControlLogix system.


| For information about: | See page: |
|---|---|
| Ownership and Connections | 2-1 |
| Using RSNetWorx and RSLogix 5000 | 2-2 |
| Direct Connections | 2-3 |
| Input Module Operation | 2-3 |
| Input Modules in a Local Chassis | 2-4 |
| Real Time Sample (RTS) | 2-4 |
| Requested Packet Interval (RPI) | 2-5 |
| Input Modules in a Remote Chassis | 2-7 |
| Output Module Operation | 2-9 |
| Output Modules in a Local Chassis | 2-9 |
| Output Modules in a Remote Chassis | 2-10 |
| Listen-Only Mode | 2-12 |
| Multiple Owners of Input Modules | 2-13 |
| Configuration Changes in an Input Module with Multiple Owners | 2-14 |


## Ownership and Connections

Every I/O module in the ControlLogix system must be owned by a ControlLogix controller to be useful. This owner-controller stores configuration data for every module that it owns and can be located locally or remotely, relative to the I/O module's position. The owner sends the I/O module configuration data to define the module's behavior and begin operation within the control system. Each ControlLogix I/O module must continuously maintain communication with its owner to operate normally.

Typically, each module in the system will have only 1 owner. Input modules can have more than 1 owner. Output modules, however, are limited to a single owner. For more information on the increased flexibility provided by multiple owners and the ramifications of using multiple owners, see page 2-13.

## Using RSNetWorx and RSLogix 5000

The I/O configuration portion of RSLogix5000 generates the configuration data for each I/O module in the control system, whether the module is located in a local or remote chassis. A remote chassis, also known as networked, contains the I/O module but not the module's owner-controller. Remote chassis can be connected to the controller via a scheduled ControlNet or EtherNet/IP network.

Configuration data is transferred to the controller during the program download and subsequently transferred to the appropriate I/O modules.

I/O modules in the local chassis, and modules in a remote chassis this connected via the EtherNet/IP network, are ready to run as soon as the configuration data has been downloaded. However, you must run RSNetWorx to enable I/O modules in a scheduled ControlNet chassis.

Running RSNetWorx transfers configuration data to I/O modules on scheduled ControlNet and establishes a Network Update Time (NUT) for ControlNet that is compliant with the desired communications options specified for each module during configuration.

Anytime a controller references an I/O module in a scheduled ControlNet chassis, you must run RSNetWorx to configure ControlNet. Follow these general guidelines when configuring I/O modules:

1. Configure all I/O modules for a given controller using RSLogix 5000 and download that information to the controller.

2. If the I/O configuration data references a module in a remote chassis connected by scheduled ControlNet, run RSNetWorx.

**IMPORTANT** You **must** run RSNetWorx whenever a new module is added to a scheduled ControlNet chassis. When a module is permanently removed from a remote chassis, we recommend that RSNetWorx be run to optimize the allocation of network bandwidth.

## Direct Connections

A **direct connection** is a real-time data transfer link between the controller and the device that occupies the slot that the configuration data references. ControlLogix analog I/O modules use direct connections only.

When module configuration data is downloaded to an owner-controller, the controller attempts to establish a direct connection to each of the modules the data references.

If a controller has configuration data referencing a slot in the control system, the controller periodically checks for the presence of a device there. When a device's presence is first detected, the controller automatically sends the configuration data and one of the following events occurs:

- If the data is appropriate to the module found in the slot, a connection is made and operation begins.
- If the configuration data is not appropriate, the data is rejected and an error message displays in the software. In this case, the configuration data can be inappropriate for any of a number of reasons.

  For example, a module's configuration data may be appropriate except for a mismatch in electronic keying that prevents normal operation.

The controller maintains and monitors its connection with a module. Any break in the connection, such as removal of the module from the chassis while under power, causes the controller to set fault status bits in the data area associated with the module. You can use ladder logic to monitor this data area and detect module failures.

## Input Module Operation

In traditional I/O systems, controllers poll input modules to obtain their input status. In the ControlLogix system, however, the owner-controller does not poll analog input modules after a connection is established. The modules multicast their data periodically. Multicast frequency depends on the options chosen during configuration and where in the control system that input module physically resides.

An input module's communication, or multicasting, behavior varies depending upon whether it operates in the local chassis or in a remote chassis, based on the network type. The following sections detail the differences in data transfers between these set-ups.

## Input Modules in a Local Chassis

When a module resides in the same chassis as the owner-controller, the following two configuration parameters will affect how and when the input module multicasts data:

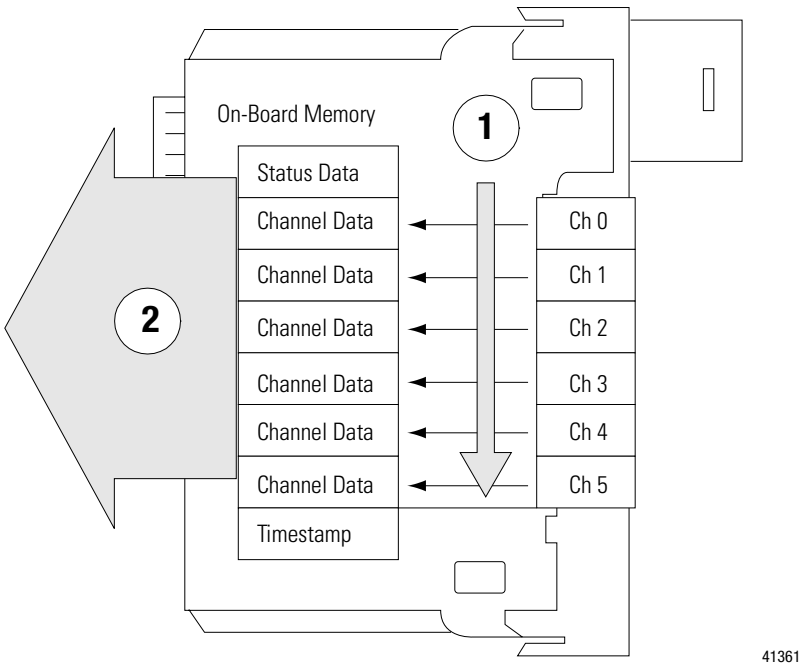
- Real Time Sample (RTS)
- Requested Packet Interval (RPI)

### Real Time Sample (RTS)

This configurable parameter instructs the module to perform the following operations:

1. **Scan all** of its input channels and store the data into on-board memory
2. Multicast the updated channel data (as well as other status data) to the backplane of the local chassis

**Figure 2.1**



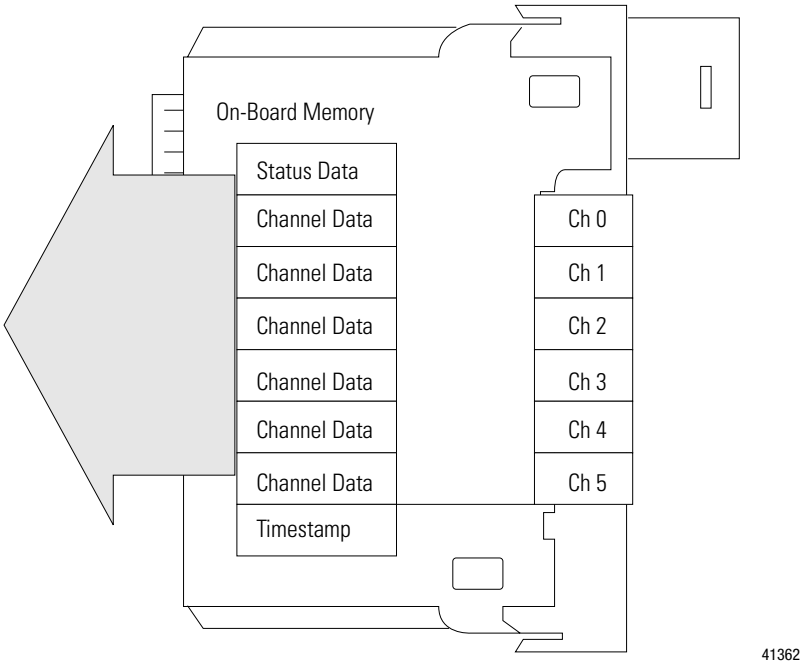

**IMPORTANT** The RTS value is set during the initial configuration using RSLogix 5000. This value can be adjusted anytime.

## Requested Packet Interval (RPI)

This configurable parameter also instructs the module to multicast its channel and status data to the local chassis backplane.

The RPI instructs the module to multicast the **current contents** of its on-board memory when the RPI expires, (i.e. the module does not update its channels prior to the multicast).

**Figure 2.2**




**IMPORTANT** The RPI value is set during the initial module configuration using RSLogix 5000. This value can be adjusted when the controller is in Program mode.

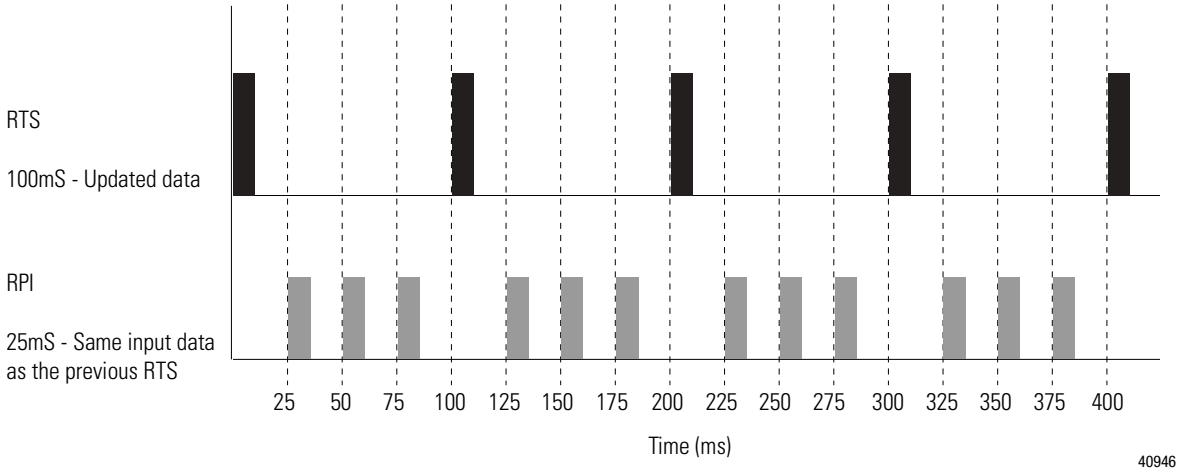
It is important to note that the module will reset the RPI timer each time an RTS is performed. This operation dictates how and when the owner-controller in the local chassis will receive updated channel data, depending on the values given to these parameters.

If the RTS value is less than or equal to the RPI, each multicast of data from the module will have updated channel information. In effect, the module is only multicasting at the RTS rate.

If the RTS value is greater than the RPI, the module multicasts at both the RTS rate and the RPI rate. Their respective values will dictate how often the owner-controller will receive data and how many multicasts from the module contain updated channel data.

In the example below, the RTS value is 100mS and the RPI value is 25mS. Only every fourth multicast from the module will contain updated channel data.

**Figure 2.3**




## Triggering Event Tasks

When configured to do so, ControlLogix analog input modules can trigger an event task. The event task offers ControlLogix controller users a task that executes a section of logic immediately when an event (i.e. receipt of new data) occurs.

Your ControlLogix analog I/O module can trigger event tasks every RTS, after the module has sampled and multicast its data. Events tasks are useful for synchronizing process variable (PV) samples and proportional integral derivative (PID) calculations.

**IMPORTANT** ControlLogix analog I/O modules can trigger event tasks at every RTS but not at the RPI. For example, in Figure 2.3 above, an event task can only be triggered every 100ms.

## Input Modules in a Remote Chassis

If an input module resides in a remote chassis, the role of the RPI and the module's RTS behavior change slightly with respect to getting data to the owner-controller, depending on what network type you are using to connect to the modules.

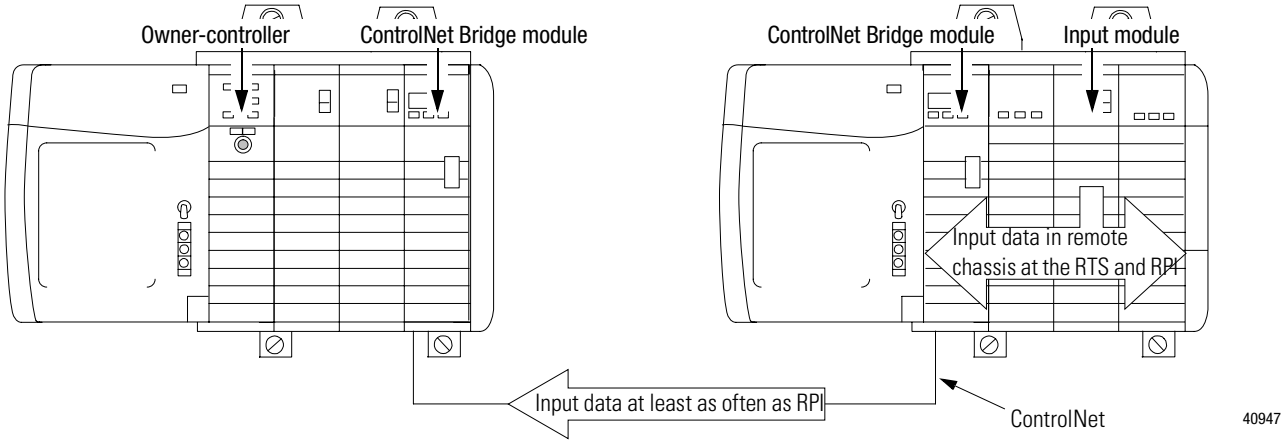
### Remote Input Modules Connected Via ControlNet

When remote analog I/O modules are connected to the owner-controller via a scheduled ControlNet network, the RPI and RTS intervals still define when the module will multicast data **within its own chassis** (as described in the previous section). However, only the value of the RPI determines how often the owner-controller will receive it over the network.

When an RPI value is specified for an input module in a remote chassis connected by a scheduled ControlNet network, in addition to instructing the module to multicast data within its own chassis, the RPI also "reserves" a spot in the stream of data flowing across the ControlNet network.

The timing of this "reserved" spot may or may not coincide with the exact value of the RPI, but the control system guarantees that the owner-controller receives data **at least as often** as the specified RPI.

**Figure 2.4 Input Module in Remote Chassis with RPI Reserving Spot in Flow of Data**




The "reserved" spot on the network and the module's RTS are asynchronous to each other. This means there are Best and Worst Case scenarios as to when the owner-controller will receive updated channel data from the module in a networked chassis.

*Best Case RTS Scenario*

In the Best Case scenario, the module performs an RTS multicast with updated channel data just before the "reserved" network slot is made available. In this case, the remotely-located owner-controller receives the data almost immediately.

*Worst Case RTS Scenario*

In the Worst Case scenario, the module performs an RTS multicast just after the "reserved" network slot has passed. In this case, the owner-controller will not receive data until the next scheduled network slot.

**TIP** Because it is the RPI and NOT the RTS which dictates when the module's data will be sent over the network, we recommend the RPI value be set LESS THAN OR EQUAL TO the RTS to make sure that updated channel data is received by the owner-controller with each receipt of data.

## Remote Input Modules Connected Via EtherNet/IP

When remote analog input modules are connected to the owner-controller via an EtherNet/IP network, data is transferred to the owner-controller in the following way:

- At the RTS or RPI (whichever is faster), the module multicasts data within its own chassis.
- The 1756-ENBT module in the remote chassis immediately sends the module's data over the network to the owner-controller as long as it has not sent data within a timeframe that is 1/4 the value of the analog input module's RPI.

  For example, if an analog input module uses an RPI = 100ms, the 1756-ENBT module will only send module data immediately on receiving it if another data packet was not sent within the last 25ms.

## Output Module Operation

The RPI parameter governs exactly when an analog output module receives data from the owner-controller and when the output module echoes data. An owner-controller sends data to an analog output module **only at the period specified in the RPI**. Data is NOT sent to the module at the end of the controller's program scan.

When an analog output module receives **new data** from an owner-controller (i.e. every RPI), the module automatically multicasts or "echoes" a data value that corresponds to the analog signal present at the output terminals to the rest of the control system. This feature, called **Output Data Echo**, occurs whether the output module is local or remote.

For more information on data echo, see the feature description in each module-specific chapter.

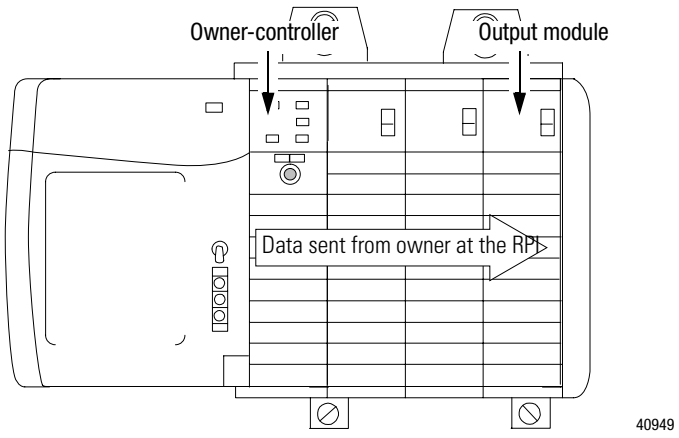
Depending on the value of the RPI, with respect to the length of the controller program scan, the output module can receive and "echo" data multiple times during one program scan.

When the RPI is less than the program scan length, the controller effectively allows the module's output channels to change values multiple times during a single program scan because the output module is not dependent on reaching the end of the program to send data.

## Output Modules in a Local Chassis

When specifying an RPI value for an analog output module, you instruct the controller when to broadcast the output data to the module. If the module resides in the same chassis as the owner-controller, the module receives the data almost immediately after the controller sends it.

**Figure 2.5**



## Output Modules in a Remote Chassis

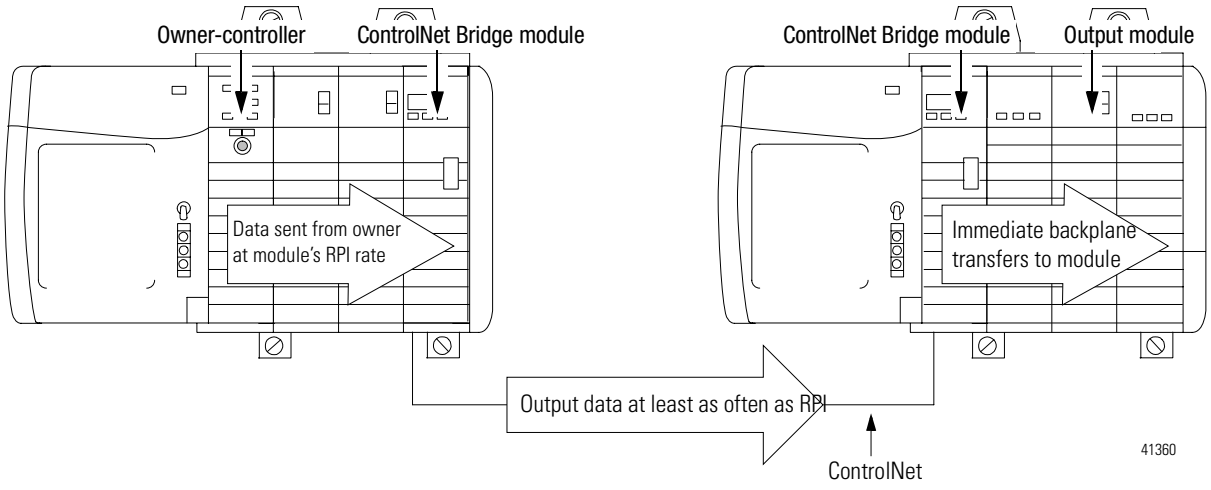
If an output module resides in a remote chassis, the role of the RPI changes slightly with respect to getting data from the owner-controller, depending on what network type you are using to connect to the modules.

### Remote Output Modules Connected Via ControlNet

When remote analog output modules are connected to the owner-controller via a scheduled ControlNet network, in addition to instructing the controller to multicast the output data within its own chassis, the RPI also "reserves" a spot in the stream of data flowing across the ControlNet network.

The timing of this "reserved" spot may or may not coincide with the exact value of the RPI, but the control system will guarantee that the output module will receive data **at least as often** as the specified RPI.

**Figure 2.6 Output Module in Remote Chassis with RPI Reserving a Spot in Flow of Data**




The "reserved" spot on the network and when the controller sends the output data are asynchronous to each other. This means there are Best and Worst Case scenarios as to when the module will receive the output data from the controller in a networked chassis.

*Best Case RPI Scenario*

In the Best Case scenario, the controller sends the output data just BEFORE the “reserved” network slot is available. In this case, the remotely located output module receives the data almost immediately.

*Worst Case RPI Scenario*

In the Worst Case scenario, the controller sends the data just AFTER the “reserved” network slot has passed. In this case, the module does not receive the data until the next scheduled network slot.

**IMPORTANT**

These Best and Worst Case scenarios indicate the time required for output data to transfer from the controller to the module **once the controller has produced it**.

The scenarios do not take into account when the module will receive NEW data (updated by the user program) from the controller. That is a function of the length of the user program and its asynchronous relationship with the RPI.

## Remote Output Modules Connected Via EtherNet/IP

When remote analog output modules are connected to the owner-controller via an EtherNet/IP network, the controller multicasts data in the following way:

- At the RPI, the owner-controller multicasts data within its own chassis.
- The 1756-ENBT module in the local chassis immediately sends the data over the network to the analog output module as long as it has not sent data within a timeframe that is 1/4 the value of the analog module’s RPI.

## Listen-Only Mode

Any controller in the system can **listen** to the data from any I/O module (e.g. input data or "echoed" output data) even if the controller does not own the module. In other words, the controller does not have to own a module's configuration data to listen to it.

During the I/O configuration process, you can specify one of several 'Listen-Only' modes in the Communication Format field. For more information on Communications Format, see page 10-6.

Choosing a 'Listen-Only' mode option allows the controller and module to establish communications without the controller sending any configuration data. In this instance, another controller owns the module being listened to.

**IMPORTANT**

Controllers using the Listen-Only mode continue to receive data multicast from the I/O module as long as a connection between an owner-controller and I/O module is maintained.

If the connection between all owner-controllers and the module is broken, the module stops multicasting data and connections to all 'Listening controllers' are also broken.

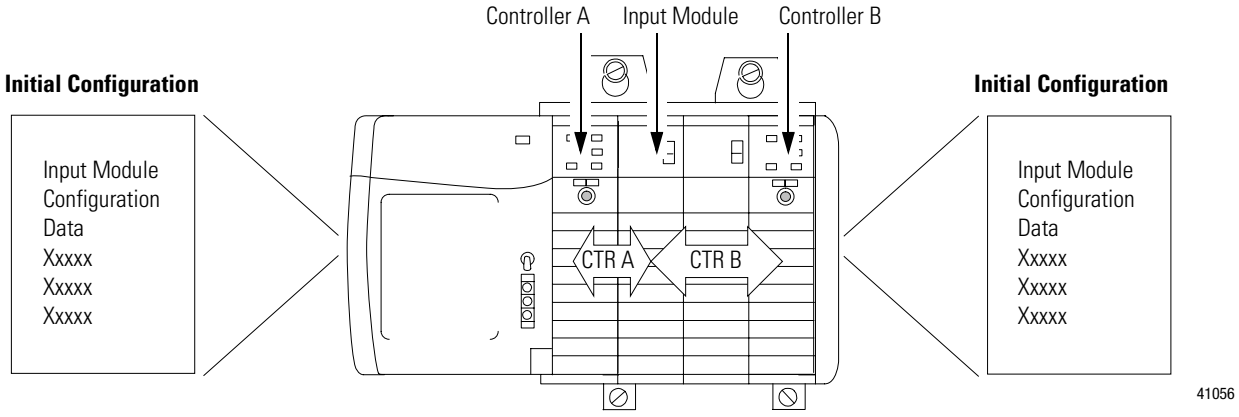
## Multiple Owners of Input Modules

Because 'Listening controllers' lose their connections to modules when communications with the owner stop, the ControlLogix system will allow you to define more than one owner for input modules.

**IMPORTANT** Only input modules can have multiple owners. If multiple owners are connected to the same input module, they **must maintain identical configuration** for that module.

In the example below, Controller A and Controller B have both been configured to be the owner of the input module.

**Figure 2.7 Multiple Owners with Identical Configuration Data**




When multiple controllers are configured to own the same input module, the following events occur:

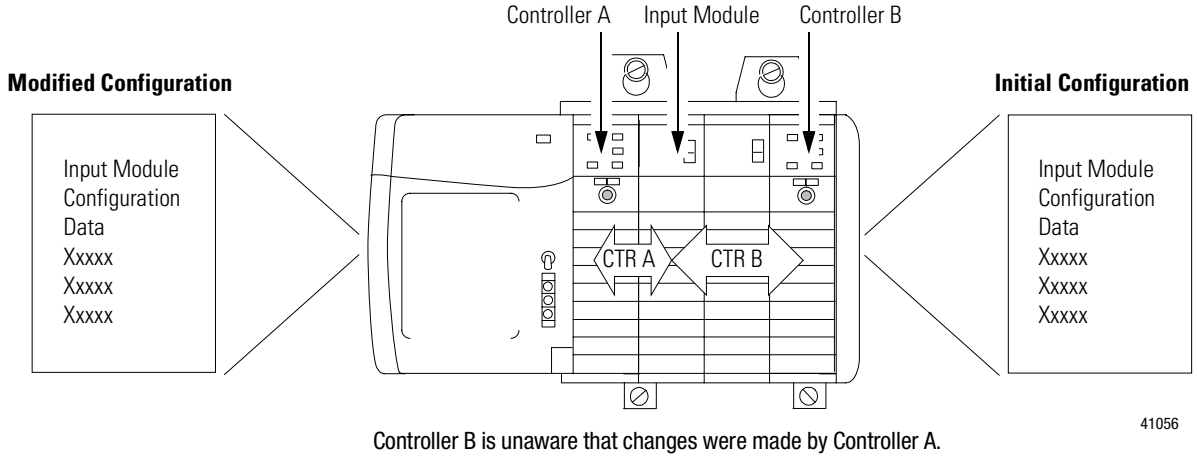
- When the controllers begin downloading configuration data, both try to establish a connection with the input module.
- Whichever controller's data arrives first establishes a connection.
- When the second controller's data arrives, the module compares it to its current configuration data (the data received and accepted from the first controller).
  - If the configuration data sent by the second controller matches the configuration data sent by the first controller the connection is also accepted.
  - If any parameter of the second configuration data is different from the first, the module rejects the connection; RSLogix 5000 alerts you to the rejected connection through an error message.

The advantage of multiple owners over a 'Listen-only' connection is that now either of the controllers can lose the connection to the module and the module will continue to operate and multicast data to the system because of the connection maintained by the other owner-controller.

## Configuration Changes in an Input Module with Multiple Owners

You must be careful when changing an input module's configuration data in a multiple owner scenario. When the configuration data is changed in one of the owners, for example, Controller A, and sent to the module, that configuration data is accepted as the new configuration for the module. Controller B continues to listen, unaware that any changes have been made in the module's behavior.

**Figure 2.8 Multiple Owners with Changed Configuration Data**




Controller B is unaware that changes were made by Controller A.

**IMPORTANT**

A pop-up screen in RSLogix 5000 alerts you to the possibility of a multiple owner situation and allows you to inhibit the connection before changing the module's configuration. When changing configuration for a module with multiple owners, we recommend the connection be inhibited.

To prevent other owners from receiving potentially erroneous data, as described above, the following steps **must be followed** when changing a module's configuration in a multiple owner scenario while online:

1. For each owner-controller, inhibit the controller's connection to the module, either in the software on the Connection tab or the pop-up screen warning of the multiple owner condition.
2. Make the appropriate configuration data changes in the software. For detailed information on using RSLogix 5000 to change configuration, see Chapter 10.
3. Repeat steps 1 and 2 for all owner-controllers, making the **exact same changes** in all controllers.
4. Disable the Inhibit box in each owner's configuration.

## Chapter Summary and What's Next

In this chapter, you learned about Analog I/O Operation Within the ControlLogix System.

Chapter 3 describes Using ControlLogix Analog I/O Module Features.

## Notes:

# Using ControlLogix Analog I/O Module Features

## What This Chapter Contains

This chapter describes features that are common to all ControlLogix analog I/O modules.


| For information about: | See page: |
|---|---|
| Determining Input Module Compatibility | 3-1 |
| Determining Output Module Compatibility | 3-1 |
| Features Common to All Analog I/O Modules | 3-2 |
| Understanding the Relationship Between Module Resolution, Scaling and Data Format | 3-11 |


## Determining Input Module Compatibility

ControlLogix analog input modules convert an analog signal of either volts, millivolts, milliamps or ohms that is connected to the module's screw terminals into a digital value.

The digital value which represents the magnitude of the analog signal is then transmitted on the backplane to either a controller or other control entities.

For more information on compatibility of other Rockwell Automation products to ControlLogix analog input modules, see the I/O Products Systems Overview, publication CIG-SO001.

## Determining Output Module Compatibility

ControlLogix output modules convert a digital value that is delivered to the module via the backplane into an analog signal of -10.5 to +10.5 volts or 0 to 21 milliamps.

The digital value represents the magnitude of the desired analog signal. The module converts the digital value into an analog signal and provides this signal on the module's screw terminals.

For more information on compatibility of other Rockwell Automation products to ControlLogix analog output modules, see the I/O Products Systems Overview, publication CIG-SO001.

## Features Common to All Analog I/O Modules

Table 3.1 lists the features that are common to all ControlLogix analog I/O modules. The features are described later in this section.

**Table 3.1**

| Feature: | Page of description: |
|---|---|
| Removal and Insertion Under Power (RIUP) | 3-2 |
| Module Fault Reporting | 3-3 |
| Fully Software Configurable | 3-3 |
| Electronic Keying | 3-4 |
| Access to System Clock for Timestamping Functions | 3-6 |
| Rolling Timestamp | 3-6 |
| Producer/Consumer Model | 3-6 |
| Status Indicator Information | 3-7 |
| Full Class I Division 2 Compliance | 3-7 |
| UL, CSA, FM, CE, C-Tick, EEx, TUV Agency Certification | 3-7 |
| Field Calibration | 3-8 |
| Sensor Offset | 3-8 |
| Latching of Alarms | 3-8 |

### Removal and Insertion Under Power (RIUP)

All ControlLogix I/O modules may be inserted and removed from the chassis while power is applied. This feature allows greater availability of the overall control system because, while the module is being removed or inserted, there is no additional disruption to the rest of the controlled process.

## Module Fault Reporting

ControlLogix analog I/O modules provide both hardware and software indication when a module fault has occurred. Each module has an LED fault indicator and RSLogix 5000 will graphically display this fault and include a fault message describing the nature of the fault. This feature allows you to determine how your module has been affected and what action should be taken to resume normal operation.

For more information on module fault reporting as it relates to specific modules, see the chapter describing that module, either chapter 4, 5, 6, 7 or 8.

## Fully Software Configurable

The RSLogix 5000 software uses a custom, easily understood interface to write configuration. All module features are enabled or disabled through the I/O configuration portion of the software.

You can also use the software to interrogate any module in the system to retrieve:

- serial number
- revision information
- catalog number
- vendor identification
- error/fault information
- diagnostic counters.

By eliminating such tasks as setting hardware switches and jumpers, the software makes module configuration easier and more reliable.

## Electronic Keying

Instead of plastic mechanical backplane keys, electronic keying allows the ControlLogix system to control what modules belong in the various slots of a configured system.

During module configuration, you must choose one of the following keying options for your I/O module:

- Exact Match
- Compatible Match
- Disable Keying

When the controller attempts to connect to and configure an I/O module (e.g. after program download), the module compares the following parameters before allowing the connection and configuration to be accepted:

- Vendor
- Product Type
- Catalog Number
- Major Revision - Change that affects the module's function or RSLogix 5000 interface
- Minor Revision - Change that does not affects the module's function or RSLogix 5000 interface (e.g. bug fixes)

The comparison is made between the keying information present in the I/O module and the keying information in the controller's program. This feature can prevent the inadvertent operation of a control system with the wrong module in the wrong slot. For example, if you select Exact Match and a module with revision 2.2 is placed in a location configured for a module with revision 2.4, the controller does not make a connection to the new module because of the mismatched revisions.

Table 3.2 describes the keying options available with your ControlLogix analog I/O module.

**Table 3.2**

| Keying option: | Definiton: |
|---|---|
| **Exact Match** | All of the parameters listed above must match or the inserted module will reject a connection to the controller. |
| **Compatible Match** | The Compatible Match mode allows an I/O module to determine whether it can emulate the module defined in the configuration sent from the controller.<br><br>With ControlLogix analog I/O modules, the module can emulate older revisions. The module will accept the configuration if the configuration's major.minor revision is less than or equal to the physical module's revision.<br><br>For example, if the configuration contains a major.minor revision of 1.7, the module inserted into the slot must have a firmware revision of 1.7 or higher for a connection to be made. When a module is inserted with a major.minor revision that is less than the revision for which the slot is configured (i.e. the module has a revison of 1.6 and the slot is configured for a module with revision 1.8), no connection is made between the controller and the I/O module. |
| | **TIP** We recommend using Compatible Match whenever possible. Remember, though, with major revision changes, the module only works to the level of the configuration. At the time of this printing, the ControlLogix analog I/O modules all used a major revision of 1.(1)<br><br>However, if a new major revision for a ControlLogix analog I/O module is released, consider this example. If a slot is configured for a module with major.minor revision of 1.7 and you insert a module with a major.minor revision of 2.3, the module works at the 1.7 level, with respect to module functions that are related to RSLogix 5000 such as interface changes. However, bug fixes that are affected by the module's firmware, would work at the 2.3 revision level.<br><br>If possible, we suggest you make sure configuration is updated to match the revision levels of all I/O modules. Failure to do so may not prevent the application from working but may defeat the purpose of upgrading your modules' revision levels. |
| **Disable Keying** | The inserted module attempts to accept a connection to the controller regardless of its type. |
| | **ATTENTION** Be extremely cautious when using the disable keying option; if used incorrectly, this option can lead to personal injury or death, property damage or economic loss. |
| | If keying is disabled, a controller makes a connection with most modules of the same type as that used in the slot configuration. For example, if a slot is configured for a 1756-IF16 (16-point non-isolated analog current/voltage input module), and a 1756-IF8 (8-point non-isolated analog current/voltage input module) is inserted into the slot, the controller may establish a connection because keying is disabled.<br><br>Even if keying is disabled, a controller will not establish a connection if the slot is configured for one module type (e.g. input module) and a module of another type (e.g. output module) is inserted in the slot. |

(1) Minor revisions are incremented by single counts such that minor level 10 (i.e. major.minor revision level = 1.10) follows minor revision level 9 (i.e. 1.9).

## Access to System Clock for Timestamping Functions

Controllers within the ControlLogix chassis maintain a system clock. This clock is also known as the Coordinated System Time (CST). You can configure your analog I/O modules to access this clock and timestamp input data or output echo data when the module multicasts to the system. You decide how to timestamp data when you choose a Communications Format. For more information on choosing a Communications Format, see page 10-6.

This feature allows for accurate calculations between events to help you identify the sequence of events in either fault conditions or in the course of normal I/O operations. The system clock can be used between multiple modules in the same chassis.

## Rolling Timestamp

Each module maintains a rolling timestamp that is unrelated to the CST. The rolling timestamp is a continuously running 15 bit timer that counts in milliseconds.

For input modules, whenever a module scans its channels, it also records the value of the rolling timestamp at that time. The user program can then use the last two rolling timestamp values and calculate the interval between receipt of data or the time when new data has been received.

For output modules, the rolling timestamp value is only updated when new values are applied to the Digital to Analog Converter (DAC).

## Producer/Consumer Model

By using the Producer/Consumer model, ControlLogix I/O modules can produce data without having been polled by a controller first. The modules produce the data and any owner or listen-only controller device can decide to consume it.

For example, an input module produces data and any number of processors can consume the data at the same time. This eliminates the need for one processor to send the data to another processor. For a more detailed explanation of this process, see Chapter 2, Analog I/O Operation Within the ControlLogix System.

## Status Indicator Information

Each ControlLogix analog I/O module has status indicators on the front of the module that allows you to check the module health and operational status of a module.

Table 3.3 describes what status each status indicator represents:

**Table 3.3**

| Status: | Description: |
|---|---|
| Calibration status | display indicates when your module is in the calibration mode |
| Module status | display indicates the module's communication status |

For examples of LED indicators on ControlLogix analog I/O modules, see Chapter 12, Troubleshooting Your ControlLogix Analog I/O Module.

## Full Class I Division 2 Compliance

All ControlLogix analog I/O modules maintain CSA Class I Division 2 system certification. This allows the ControlLogix system to be placed in an environment other than only a 100% hazard free.

**IMPORTANT** Modules should not be pulled under power, nor should a powered RTB be removed, when a hazardous environment is present.

## UL, CSA, FM, CE, C-Tick, EEx, TUV Agency Certification

Any ControlLogix analog I/O modules that have obtained various agency certifications are marked as such. Ultimately, all analog modules will have these agency approvals and be marked accordingly.

## Field Calibration

ControlLogix analog I/O modules allow you to calibrate on a channel-by-channel or module-wide basis. RSLogix 5000 provides a software interface to perform calibration.

To see how to calibrate your module, see Chapter 11, Calibrating the ControlLogix Analog I/O Modules.

## Sensor Offset

You can add this offset directly to the input or output during calibration calculation. The purpose of this feature is to allow you to compensate for any sensor offset errors which may exist, such offset errors are common in thermocouple sensors.

To see how to set the sensor offset, see page 10-10.

## Latching of Alarms

The latching feature allows analog I/O modules to latch an alarm in the set position once it has been triggered, even if the condition causing the alarm to occur disappears.

## Data Format

During initial configuration of any ControlLogix analog I/O module, you must choose a Communications Format. The format chosen determines the data format of data exchanged between the owner-controller and the I/O module. For more information on choosing a Communications Format, see page 10-6.

Your analog module multicasts data in the formats listed in Table 3.4.

**Table 3.4**

| Format type: | Description: |
|---|---|
| Integer | This mode uses a 16-bit signed format and allows faster sampling rates while using less memory in the controller but also limits the availability of features on your module.<br><br>The faster sampling rates and lower memory usage vary according to module and application type. For more information on the specific sampling rates, see the Module Filter section in the module-specific chapters. Memory usage can be up to 50% less than in floating point. |
| Floating point | This mode uses a 32 bit IEEE floating point format. |

Your choice of data format may restrict the features available with an I/O module. For example, if you use an integer data format with the 1756-OF6CI module, the Clamping feature is not available for use. For specific listings of what features are available and not available see the individual chapters for each catalog number.

**TIP**

We recommend that you use the floating point data format in most applications. Floating point is simpler to use and offer all module features. All ControlLogix analog I/O module default to floating point when initialled configured.

You should only use the integer data format if your application requires faster sampling rates than offered in in floating point or if you application memory is extremely limited.

For a more detailed explanation of Data Formats, as they relate to module resolution and scaling, see the next section.

## Module Inhibiting

Module inhibiting allows you to indefinitely suspend a connection between an owner-controller and an analog I/O module. This process can occur in either of the following ways:

- You write configuration for an I/O module but inhibit the module to prevent it from communicating with the owner-controller. In this case, the owner does not establish a connection and configuration is not sent to the module until the connection is uninhibited.
- In your application, a controller already owns a module, has downloaded configuration to the module and is currently exchanging data over the connection between the devices. In this case, you can inhibit the module and the owner-controller behaves as if the connection to the module does not exist.

**IMPORTANT** Whenever you inhibit an output module, it enters the program mode and all outputs change to the state configured for the program mode. For example, if an output module is configured so that the state of the outputs go to zero (0) during program mode, whenever that module is inhibited, the outputs will go to zero (0).

The following examples are instances where you may need to use module inhibiting:

- Multiple controllers own the same analog input module. A change is required in the module's configuration; however, the change must be made to the program in all controllers. In this case, you can:
  a. Inhibit the module.
  b. Change configuration in all controllers.
  c. Unihibit the module.

- You want to FLASH upgrade an analog I/O module. We recommend you:
  a. Inihibit the module.
  b. Perform the upgrade.
  c. Uninhibit the module.

- You are using a program that includes a module that you do not physically possess yet, but you do not want the controller to continually look for a module that does not exist yet. In this case, you can inhibit the module in your program until it physically resides in the proper slot.

## Understanding the Relationship Between Module Resolution, Scaling and Data Format

The following three concepts are closely related and must be explained in conjunction with each other:

- Module Resolution
- Scaling
- Data Format as Related to Resolution and Scaling

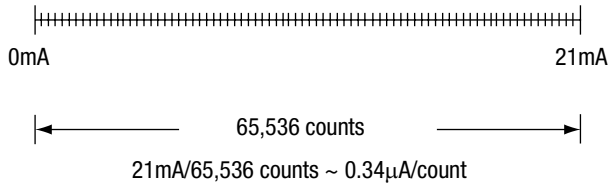
### Module Resolution

Resolution is the smallest amount of change that the module can detect. Analog input modules are capable of 16 bit resolution. Output modules are capable of 13-16 bit resolution, depending on the module type.

The 16 bits represent 65,536 counts. This total is fixed but the value of each count is determined by the operational range you choose for your module.

For example, if you are using the 1756-IF6I module, your module's available current range equals 21mA. Divide your range by the number of counts to figure out the value of each count. In this case, one count is approximately 0.34μA.

**Figure 3.1 Module Resolution**




**IMPORTANT** A module's resolution is fixed. It will not change regardless of what data format you choose or how you decide to scale your module in floating point mode.

Resolution is based on the module hardware and the range selected. If you use a sensor with limited range, you do not change the module resolution.

Table 3.5 lists the resolution for each module's range.

**Table 3.5 Current Values Represented in Engineering Units**

| Module: | Range: | Number of significant bits: | Resolution: |
|---|---|---|---|
| 1756-IF16 and 1756-IF8 | +/- 10.25V | 16 bits | 320μV/count |
| | 0V - 10.25V | | 160μV/count |
| | 0V - 5.125V | | 80μV/count |
| | 0mA - 20.5mA | | 0.32μA/count |
| 1756-IF6CIS | 0mA - 21mA | 16 bits | 0.34μA/count |
| 1756-IF6I | +/- 10.5V | 16 bits | 343μV/count |
| | 0V - 10.5V | | 171μV/count |
| | 0V - 5.25V | | 86μV/count |
| | 0mA - 21mA | | 0.34μA/count |
| 1756-IR6I | 1Ω - 487Ω | 16 bits | 7.7mΩ/count |
| | 2Ω - 1000Ω | | 15mΩ/count |
| | 4Ω - 2000Ω | | 30mΩ/count |
| | 8Ω - 4020Ω | | 60mΩ/count |
| 1756-IT6I and 1756-IT6I2 | -12mV - 30mV | 16 bits | 0.7μV/count |
| | -12mV - 78mV | | 1.4μV/count |
| 1756-OF4 and 1756-OF8 | +/- 10.4V | 16 bits | 320μV/count |
| | 0mA - 21mA | 15 bits | 0.65μA/count |
| 1756-OF6VI | +/- 10.5V | 14 bits | 1.3mV |
| 1756-OF6CI | 0mA - 21mA | 13 bits | 2.7μA |

**IMPORTANT** Because these modules must allow for possible calibration inaccuracies, resolution values represent the available Analog to Digital or Digital to Analog counts over the specified range.

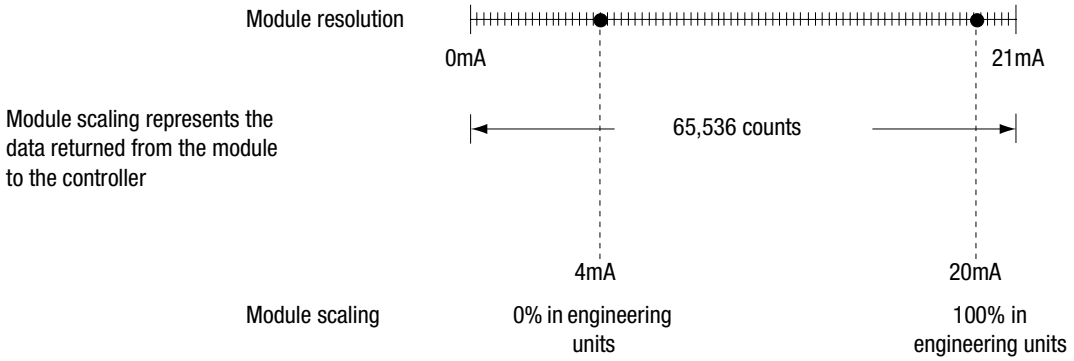
## Scaling

With scaling, you change a quantity from one notation to another. For ControlLogix analog I/O modules, scaling is **only available with the floating point data format**.

When you scale a channel, you must choose two points along the module's operating range and apply low and high values to those points. For example, if you are using the 1756-IF6I module in current mode, the module maintains a 0mA to 21mA range capability. But your application may use a 4mA to 20mA transmitter. You can scale the module to represent 4mA as the low signal and 20mA as the high signal.

Scaling allows you to configure the module to return data to the controller so that 4mA returns a value of 0% in engineering units and 20mA returns a value of 100% in engineering units.

**Figure 3.2 Module Resolution Compared to Module Scaling**




**IMPORTANT** In choosing two points for the low and high value of your application, you do not limit the range of the module. The module's range and its resolution remain constant regardless of how you scale it for your application.

The module may operate with values beyond the 4mA to 20mA range. If an input signal beyond the low and high signals is present at the module (e.g. 3mA), that data will be represented in terms of the engineering units set during scaling. Table 3.5 shows example values that may appear based on the example mentioned above.

**Table 3.6 Current Values Represented in Engineering Units**

| Current: | Engineering units value: |
|---|---|
| 3mA | -6.25% |
| 4mA | 0% |
| 12mA | 50% |
| 20mA | 100% |
| 21mA | 106.25% |

## Data Format as Related to Resolution and Scaling

You can choose one of the following data formats for your application:

- Integer mode
- Floating point mode

*Integer mode*

This mode provides the most basic representation of analog data. When a module multicasts data in the integer mode, the low and high signals of the input range are fixed.

**IMPORTANT** Scaling is not available in integer mode. The low signal of your application range equals -32,768 counts while the high signal equals 32,767 counts.

In integer mode, input modules generate digital signal values that correspond to a range from -32,768 to 32,767 counts.

Table 3.7 lists the conversions of a generated digital signal to the number of counts.

**Table 3.7 Input Signal to User Count Conversion**

| Input module: | Available range: | Low signal and user counts: | High signal and user counts: |
|---|---|---|---|
| 1756-IF16/IF8 | +/- 10V | -10.25V<br>-32768 counts | 10.25V<br>32767 counts |
| | 0V - 10V | 0V<br>-32768 counts | 10.25V<br>32767 counts |
| | 0V - 5V | 0V<br>-32768 counts | 5.125V<br>32767 counts |
| | 0mA - 20mA | 0mA<br>-32768 counts | 20.58mA<br>32767 counts |
| 1756-IF6CIS | 0mA - 20mA | 0mA<br>-32768 counts | 21.09376mA<br>32767 counts |
| 1756-IF6I | +/- 10V | -10.54688V<br>-32768 counts | 10.54688V<br>32767 counts |
| | 0V - 10V | 0V<br>-32768 counts | 10.54688V<br>32767 counts |
| | 0V - 5V | 0V<br>-32768 counts | 5.27344V<br>32767 counts |
| | 0mA - 20mA | 0mA<br>-32768 counts | 21.09376mA<br>32767 counts |
| 1756-IR6I | 1Ω – 487Ω | 0.859068653Ω<br>-32768 counts | 507.862Ω<br>32767 counts |
| | 2Ω – 1000Ω | 2Ω<br>-32768 counts | 1016.502Ω<br>32767 counts |
| | 4Ω – 2000Ω | 4Ω<br>-32768 counts | 2033.780Ω<br>32767 counts |
| | 8Ω – 4020Ω | 8Ω<br>-32768 counts | 4068.392Ω<br>32767 counts |
| 1756-IT6I and 1756-IT6I2 | -12mV - 30mV | -15.80323mV<br>-32768 counts | 31.396mV<br>32767 counts |
| | -12mV - 78mV | -15.15836mV<br>-32768 counts | 79.241mV<br>32767 counts |

Output modules allow you to generate an analog signal at the screw terminals that correspond to a range from -32,768 to 32,767 counts.

Table 3.8 lists the conversions a generated digital signal to the number of counts.

**Table 3.8 Output Signal to User Count Conversion**

| Output module: | Available range: | Low signal and user counts: | High signal and user counts: |
|---|---|---|---|
| 1756-OF4/OF8 | 0mA - 20mA | 0mA<br>-32768 counts | 21.2916mA<br>32767 counts |
| | +/- 10V | -10.4336V<br>-32768 counts | 10.4336V<br>32767 counts |
| 1756-OF6CI | 0mA - 20mA | 0mA<br>-32768 counts | 21.074mA<br>32767 counts |
| 1756-OF6VI | +/- 10V | -10.517V<br>-32768 counts | 10.517V<br>32767 counts |

*Floating point mode*

This data type mode allows you to change the data representation of the selected module. Although the full range of the module does not change, you can **scale** your module to represent I/O data in terms specific for your application.

For example, if you are using the 1756-IF6I module in floating point mode and choose an input range of 0mA to 20mA, the module can use signals within the range of 0mA to 21mA but you can scale the module to represent data between 4mA to 20mA as the low and high signals in engineering units as shown in Figure 3.1 on page 3-11.

For an example of how to define data representation in engineering units through RSLogix 5000, see page 10-10.

*Difference Between Integer and Floating Point*

The key difference between choosing integer mode or floating point mode is that integer is fixed between -32,768 and 32,767 counts and floating point mode provides scaling to represent I/O data in specific engineering units for your application. Module resolution remains constant between the formats at 0.34µA/count.

For example, Table 3.9 shows the difference in the data returned from the 1756-IF6I module to the controller between data formats. In this case, the module uses the 0mA-20mA input range with 0mA scaled to 0% and 20mA scaled to 100%, as shown in Figure 3.1 on page 3-11.

**Table 3.9 Difference Between Data Formats in Applications Using the 1756-IF6I Module and An Input Range of 0mA to 20mA**

| Signal value: | Fixed number of counts in integer mode: | Data representation in floating point mode (Engineering units): |
|---|---|---|
| 0mA | -32768 counts | -25% |
| 4mA | -20341 counts | 0% |
| 12mA | 4514 counts | 50% |
| 20mA | 29369 counts | 100% |
| 21.09376mA | 32767 counts | 106.25% |

## Chapter Summary and What's Next

In this chapter you learned about using features common to all ControlLogix analog I/O modules

Move to Chapter 4 to learn about non-isolated analog input modules.

## Notes:

# Non-Isolated Analog Voltage/Current Input Modules (1756-IF16, -IF8)

## What This Chapter Contains

This chapter describes features specific to ControlLogix non-isolated analog voltage/current input modules.


| For information about: | See page: |
|---|---|
| Choosing a Wiring Method | 4-2 |
| Choosing a Data Format | 4-4 |
| Features Specific to Non-Isolated Analog Input Modules | 4-5 |
| Using Module Block and Input Circuit Diagrams | 4-12 |
| Wiring the 1756-IF16 Module | 4-15 |
| Wiring the 1756-IF8 Module | 4-19 |
| 1756-IF16 Module Fault and Status Reporting | 4-23 |
| 1756-IF8 Module Fault and Status Reporting | 4-30 |


In addition to the features described in this chapter, the non-isolated analog voltage/current input modules support all features described in Chapter 3. Table 4.1 lists additional features that your non-isolated analog voltage/current input modules support.

**Table 4.1 Additional Features Supported by the Non-Isolated Analog Input Modules**

| Feature: | Page of description: |
|---|---|
| Removal and Insertion Under Power (RIUP) | 3-2 |
| Module Fault Reporting | 3-3 |
| Fully Software Configurable | 3-3 |
| Electronic Keying | 3-4 |
| Access to System Clock for Timestamping Functions | 3-6 |
| Rolling Timestamp | 3-6 |
| Producer/Consumer Model | 3-6 |
| Status Indicator Information | 3-7 |
| Full Class I Division 2 Compliance | 3-7 |
| UL, CSA, FM, CE, C-Tick, EEx, TUV Agency Certification | 3-7 |
| Field Calibration | 3-8 |
| Sensor Offset | 3-8 |
| Latching of Alarms | 3-8 |

## Choosing a Wiring Method

The 1756-IF16 and 1756-IF8 modules support the following three wiring methods:

- Single-Ended Wiring Method
- Differential Wiring Method
- High Speed Mode Differential Wiring Method

After determining which wiring method you will use on your module, you must inform the system of that choice when you choose a Communications Format. For more information on choosing a Communications Format, see page 10-6.

For examples of each wiring format on the 1756-IF16 module, see the examples beginning on page 4-15. For examples of each wiring format on the 1756-IF8 module, see the examples beginning on page 4-19.

### Single-Ended Wiring Method

Single-ended wiring compares one side of the signal input to signal ground. This difference is used by the module in generating digital data for the controller.

When using the single-ended wiring method, all input devices are tied to a common ground. In addition to the common ground, the use of single-ended wiring maximizes the number of usable channels on the module (8 channels for 1756-IF8 module & 16 channels for the 1756-IF16).

## Differential Wiring Method

The differential wiring method is recommended for applications in which it is advantageous or required to have separate signal pairs or a common ground is not available. Differential wiring is recommended for environments where improved noise immunity is needed.

**IMPORTANT** This wiring method allows use of only half a module's channels. For example, you can only use 8 channels on the 1756-IF16 module and 4 channels on the 1756-IF8 module.

## High Speed Mode Differential Wiring Method

You can configure the 1756-IF16 and 1756-IF8 modules for a high speed mode that will give you the fastest data updates possible. When using the high speed mode, remember the following conditions:

- This mode uses the differential wiring method
- This mode only allows use of 1 out of every 4 channels on the module

Update times for applications using the high speed mode can be found in Table 4.5 on page 4-6.

## Choosing a Data Format

Data format determines the format of the data returned from the module to the owner-controller and the features that are available to your application. You choose a data format when you choose a Communications Format. For more information on Communications Format, see page 10-6.

You can choose one of the two following data formats:

- Integer mode
- Floating point mode

Table 4.2 shows which features are available in each format.

**Table 4.2 Features Available in Each Data Format**

| Data format: | Features available: | Features not available: |
|---|---|---|
| Integer mode | Multiple input ranges | Process alarms |
| | Module filter | Digital filtering |
| | Real time sampling | Rate alarms |
| | | Scaling |
| Floating point mode | All features | See below |

**IMPORTANT** When using the **1756-IF16** module in **single-ended** mode (i.e. 16 channel mode) with floating point data format, **process alarms and rate alarms** are **not available**.

This condition exists only when the 1756-IF16 is wired for single-ended mode. The 1756-IF8 is not affected.

## Features Specific to Non-Isolated Analog Input Modules

Table 4.3 lists features that are specific to the 1756-IF16 and 1756-IF8 modules. The features are described later in this section.

**Table 4.3**

| Feature: | Page of description: |
|---|---|
| Multiple Input Ranges | 4-5 |
| Module Filter | 4-6 |
| Real Time Sampling | 4-7 |
| Underrange/Overrange Detection | 4-7 |
| Digital Filter | 4-8 |
| Process Alarms | 4-9 |
| Rate Alarm | 4-10 |
| Wire Off Detection | 4-10 |

### Multiple Input Ranges

You can select from a series of operational ranges for **each channel** on your module. The range designates the minimum and maximum signals that are detectable by the module.

**Table 4.4 Possible Input Ranges**

| Module: | Possible ranges: |
|---|---|
| 1756-IF16 and 1756-IF8 | -10 to 10V |
| | 0 to 5V |
| | 0 to 10V |
| | 0 to 20mA |

For an example of how to choose an input range for your module, see page 10-10.

## Module Filter

The module filter is a built-in feature of the Analog-to-Digital convertor which attenuates the input signal beginning at the specified frequency. This feature is applied on a module-wide basis.

The module attenuates the selected frequency by approximately -3dB or 0.707 of the applied amplitude. This selected frequency is also called the bandwidth of the module.

An input signal with frequencies above the selected frequency will be attenuated more while frequencies below the selection will receive no attenuation.

In addition to frequency rejection, a by-product of the filter selection is the minimum sample rate (RTS) that is available. For example, in floating point mode, the 1000Hz selection will not attenuate any frequencies less than 1000Hz but will allow sampling of all 16 channels within 18ms. But the 10Hz selection attenuates all frequencies above 10Hz and only allow sampling all 16 channels within 488ms.

**IMPORTANT** 60Hz is the default setting for the module filter. This setting provides approximately 3dB of filtering of a 60Hz input.

Use Table 4.5 to choose a module filter setting.

**Table 4.5 Notch Filter Selections with Associated Performance Data**

| Module Filter Setting (-3dB)[1] [2] | Wiring Mode | 10Hz | 50Hz/60Hz (Default) | 100Hz | 250Hz | 1000Hz |
|---|---|---|---|---|---|---|
| Minimum Sample Time (RTS) | Single-Ended | 488ms | 88ms | 56ms | 28ms | 16ms |
| Integer Mode | Differential | 244ms | 44ms | 28ms | 14ms | 8ms |
| | High Speed Differential | 122ms | 22ms | 14ms | 7ms | 5ms |
| Minimum Sample Time (RTS) | Single-Ended | 488ms | 88ms | 56ms | 28ms | 18ms |
| Floating Point Mode | Differential | 244ms | 44ms | 28ms | 14ms | 11ms |
| | High Speed Differential | 122ms | 22ms | 14ms | 7ms | 6ms |
| Effective Resolution | | 16 bits | 16 bits | 16 bits | 14 bits | 12 bits |

(1) For optimal 50/60Hz noise rejection (>80dB), choose the 10Hz filter.

(2) Worst case settling time to 100% of a step change is double the RTS sample times

To see how to choose a Module Filter, see page 10-10.

## Real Time Sampling

This parameter instructs the module how often to scan its input channels and obtain all available data. After the channels are scanned, the module multicasts that data. This feature is applied on a module-wide basis.

During module configuration, you specify a Real Time Sampling (RTS) period and a Requested Packet Interval (RPI) period. Both of these features instruct the module to multicast data, but only the RTS feature instructs the module to scan its channels before multicasting.

For more information on Real Time Sampling, see page 2-4. For an example of how to set the RTS rate, see page 10-10.

## Underrange/Overrange Detection

This feature detects when the non-isolated input module is operating beyond limits set by the input range. For example, If you are using the 1756-IF16 module in the 0V-10V input range and the module voltage increases to 11V, the Overrange detection detects this condition.

Use the following table to see the input ranges of non-isolated input modules and the lowest/highest signal available in each range before the module detects an underrange/overrange condition:

**Table 4.6 Low and High Signal Limits on Non-Isolated Input Modules**

| Input module: | Available range: | Lowest signal in range: | Highest signal in range: |
|---|---|---|---|
| 1756-IF16 and 1756-IF8 | +/- 10V | -10.25V | 10.25V |
| | 0V-10V | 0V | 10.25V |
| | 0V-5V | 0V | 5.125V |
| | 0mA-20mA | 0mA | 20.58mA |

## Digital Filter

The digital filter smooths input data noise transients for all channels on the module. This feature is applied on a **per channel** basis.

The digital filter value specifies the time constant for a digital first order lag filter on the input. It is specified in units of milliseconds. A value of 0 disables the filter.

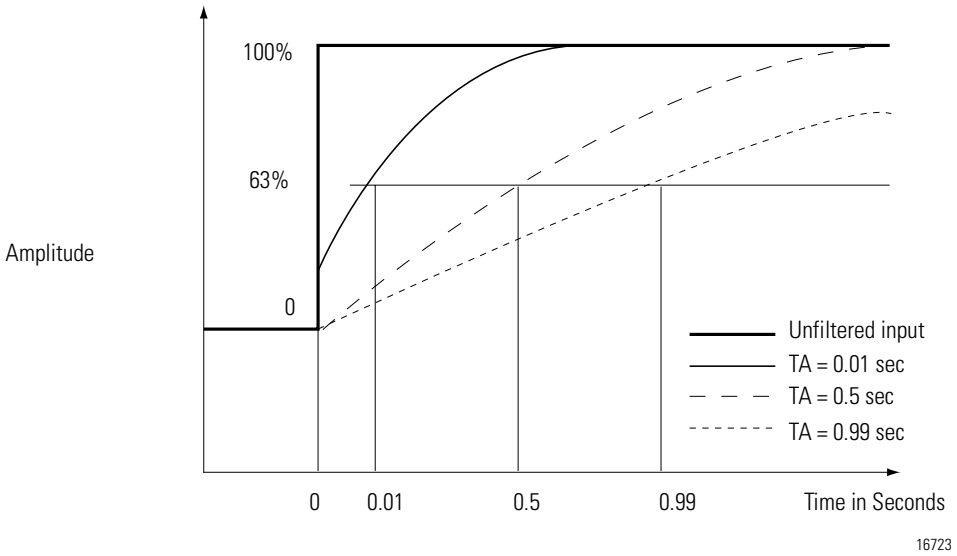
The digital filter equation is a classic first order lag equation.

$$Yn = Yn\text{-}1 + \frac{[\Delta t]}{\Delta t + TA} (X_n - Y_n\text{-}1)$$

Yn = present output, filtered peak voltage (PV)
Yn-1 = previous output, filtered PV
$\Delta t$ = module channel update time (seconds)
TA = digital filter time constant (seconds)
Xn = present input, unfiltered PV

Using a step input change to illustrate the filter response, as shown in Figure 4.1, you can see that when the digital filter time constant elapses, 63.2% of the total response is reached. Each additional time constant achieves 63.2% of the remaining response.

**Figure 4.1**




To see how to set the Digital Filter, see page 10-10.

## Process Alarms

Process alarms alert you when the module has exceeded configured high or low limits for **each channel**. You can latch process alarms. These are set at four user configurable alarm trigger points:

- High high
- High
- Low
- Low low

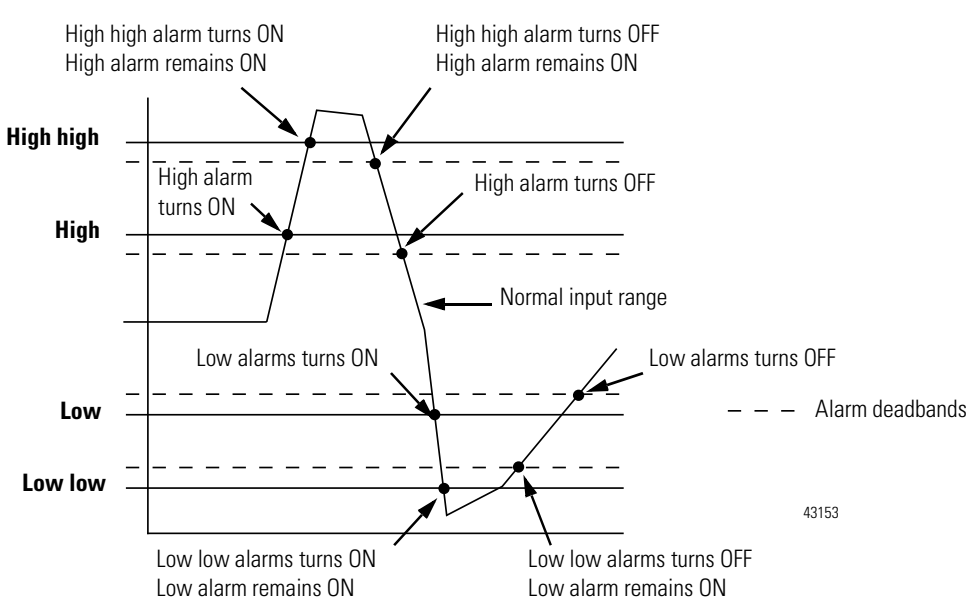
**IMPORTANT** Process alarms are not available in integer mode or in applications using 1756-IF16 module in the single-ended, floating point mode. The values for each limit are entered in scaled engineering units.

### *Alarm Deadband*

You may configure an **Alarm Deadband** to work with the process alarms. The deadband allows the process alarm status bit to remain set, despite the alarm condition disappearing, as long as the input data remains within the deadband of the process alarm.

Figure 4.2 shows input data that sets each of the four alarms at some point during module operation. In this example, Latching is disabled; therefore, each alarms turns OFF when the condition that caused it to set ceases to exist.

**Figure 4.2**




To see how to set Process Alarms, see page 10-10.

## Rate Alarm

The rate alarm triggers if the rate of change between input samples for **each channel** exceeds the specified trigger point for that channel.

**IMPORTANT** Rate alarms are not available in integer mode or in applications using 1756-IF16 module in the single-ended, floating point mode. The values for each limit are entered in scaled engineering units.

For example, if you set the 1756-IF16 (with normal scaling in Volts) to a rate alarm of 1.0 V/S, the rate alarm will only trigger if the difference between measured input samples changes at a rate > 1.0 V/S.

If the module's RTS is 100 ms (i.e. sampling new input data every 100ms) and at time 0, the module measures 5.0 volts and at time 100ms measures 5.08 V, the rate of change is (5.08V - 5.0V) / (100mS) = 0.8 V/S. The rate alarm would not set as the change is less than the trigger point of 1.0V/s.

If the next sample taken is 4.9V, the rate of change is (4.9V-5.08V)/(100mS)=-1.8V/S. The absolute value of this result is > 1.0V/S, so the rate alarm will set. Absolute value is applied because rate alarm checks for the magnitude of the rate of change being beyond the trigger point, whether a positive or negative excursion.

To see how to set the Rate Alarm, see page 10-10.

## Wire Off Detection

The 1756-IF16 and 1756-IF8 modules will alert you when a **signal wire only** has been disconnected from one of its channels or the RTB has been removed from the module. When a wire off condition occurs for this module, two events occur:

- Input data for that channel changes to a specific scaled value
- A fault bit is set in the owner-controller which may indicate the presence of a wire off condition

Because the 1756-IF16 and 1756-IF8 modules can be applied in voltage or current applications, differences exist as to how a wire off condition is detected in each application.

Table 4.7 lists the differences that occur when a wire off condition occurs in various applications.

**Table 4.7**

| When the Wire Off condition occurs in this application: | The following events occur: |
|---|---|
| Single-Ended Voltage Applications | • Input data for **odd numbered channels** changes to the scaled value associated with the **underrange** signal value of the selected operational range in floating point mode (minimum possible scaled value) or -32,767 counts in integer mode<br>• The ChxUnderrange (x=channel number) tag is set to 1<br>• Input data for **even numbered channels** changes to the scaled value associated with the **overrange** signal value of the selected operational range in floating point mode (maximum possible scaled value) or 32,767 counts in integer mode<br>• The ChxOverrange (x=channel number) tag[1] is set to 1 |
| Single-Ended Current | • Input data for that channel changes to the scaled value associated with the **underrange** signal value of the selected operational range in floating point mode (minimum possible scaled value) or -32,768 counts in integer mode<br>• The ChxUnderrange (x=channel number) tag is set to 1 |
| Differential Voltage | • Input data for that channel changes to the scaled value associated with the **overrange** signal value of the selected operational range in floating point mode (maximum possible scaled value) or 32,768 counts in integer mode<br>• The ChxOverrange (x=channel number) tag is set to 1 |
| Differential Current Applications | • Input data for that channel changes to the scaled value associated with the **underrange** signal value of the selected operational range in floating point mode (minimum possible scaled value) or -32,768 counts in integer mode<br>• The ChxUnderrange (x=channel number) tag is set to 1<br>In current applications, if wire off detection occurs for one of the following reasons:<br>• because the RTB has been disconnected from the module<br>• both the signal wire and the jumper wire have been disconnected<br>the module reacts with the same conditions as described in differential voltage applications. |

(1) For more information about tags in the tag editor, see Appendix B.

# Using Module Block and Input Circuit Diagrams

This section shows the 1756-IF16 and 1756-IF8 modules' block diagrams and input circuit diagrams.

## Module Block Diagrams

**Figure 4.3 1756-IF16 Module Block Diagram**

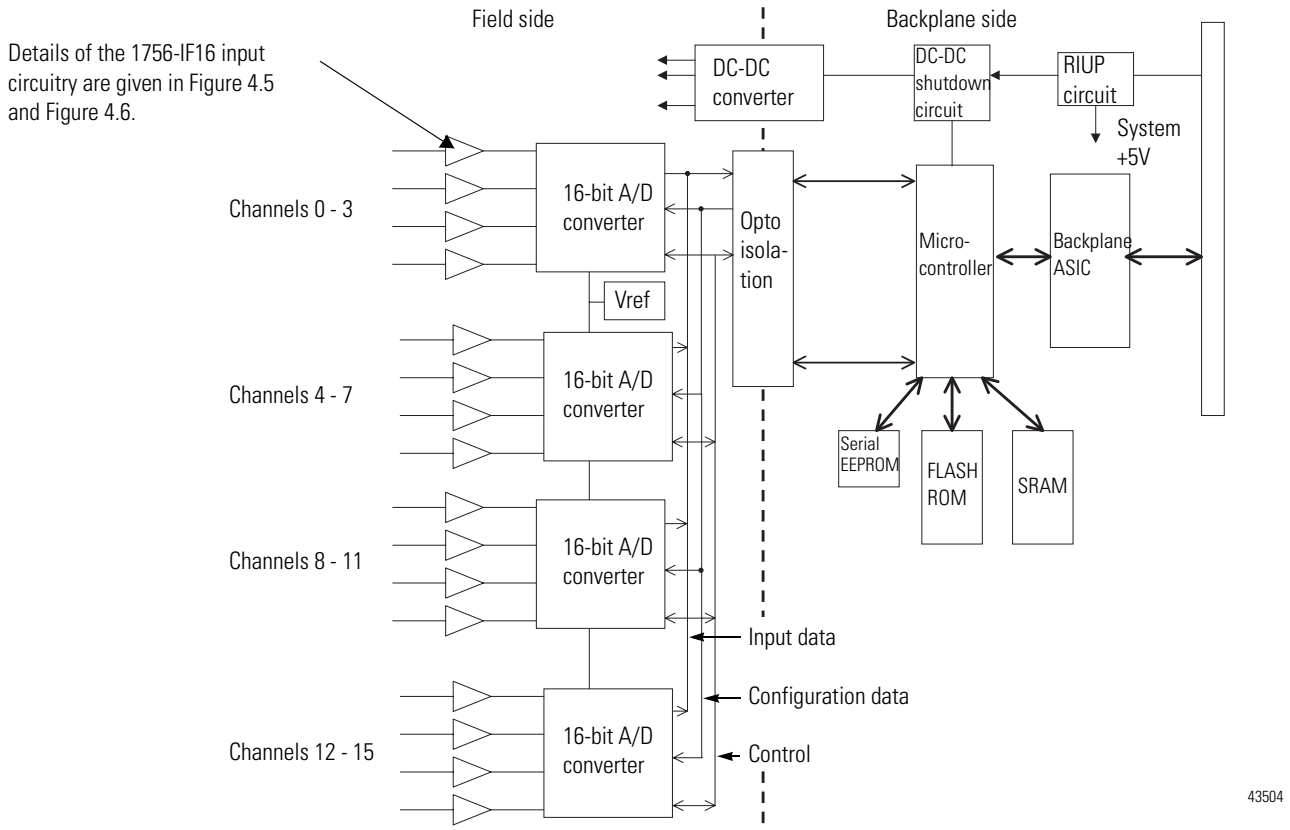
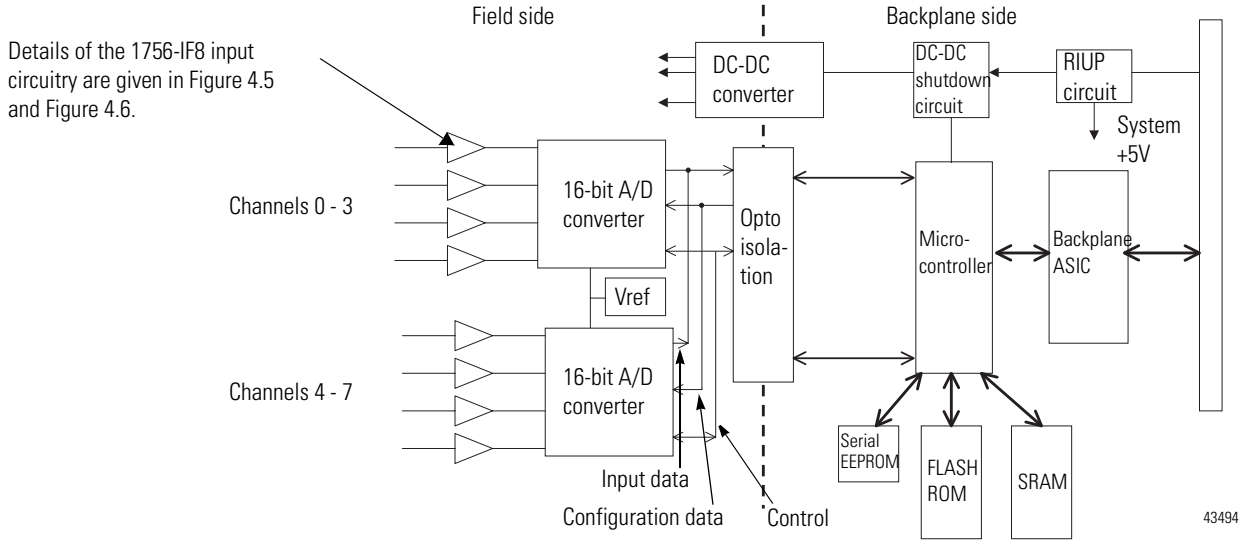



**Figure 4.4 1756-IF8 Module Block Diagram**

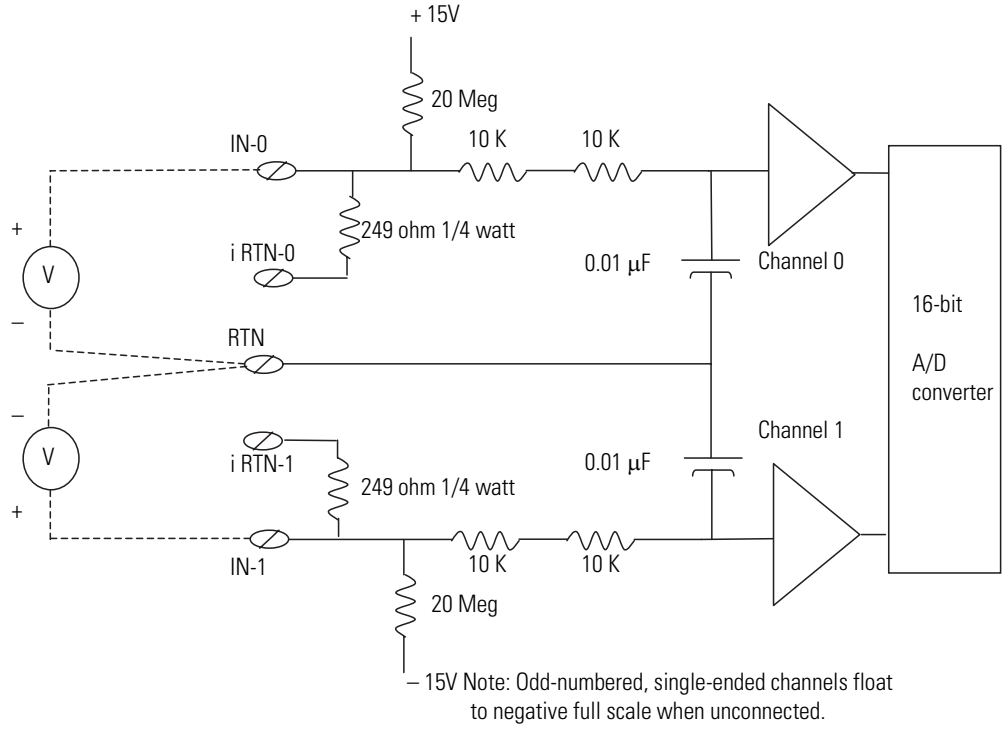


## Field Side Circuit Diagrams

The field side circuit diagrams are the same for both the 1756-IF16 and 1756-IF8 modules.

**Figure 4.5 1756-IF16 and 1756-IF8 Voltage Input Circuit**

**Single-Ended Voltage Inputs**




**Differential Voltage Inputs**

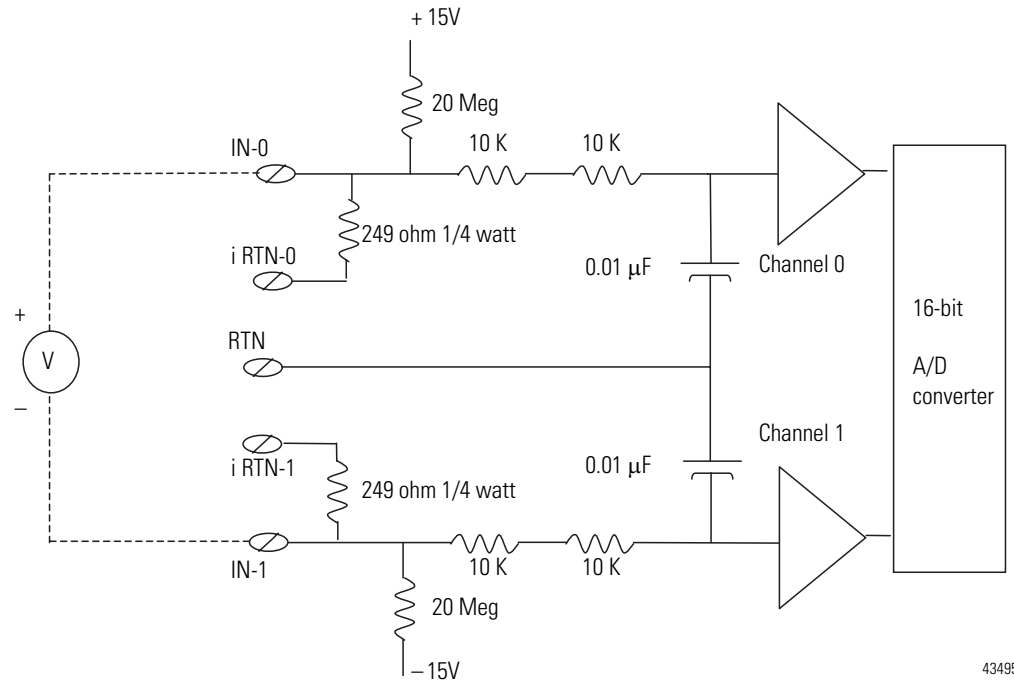
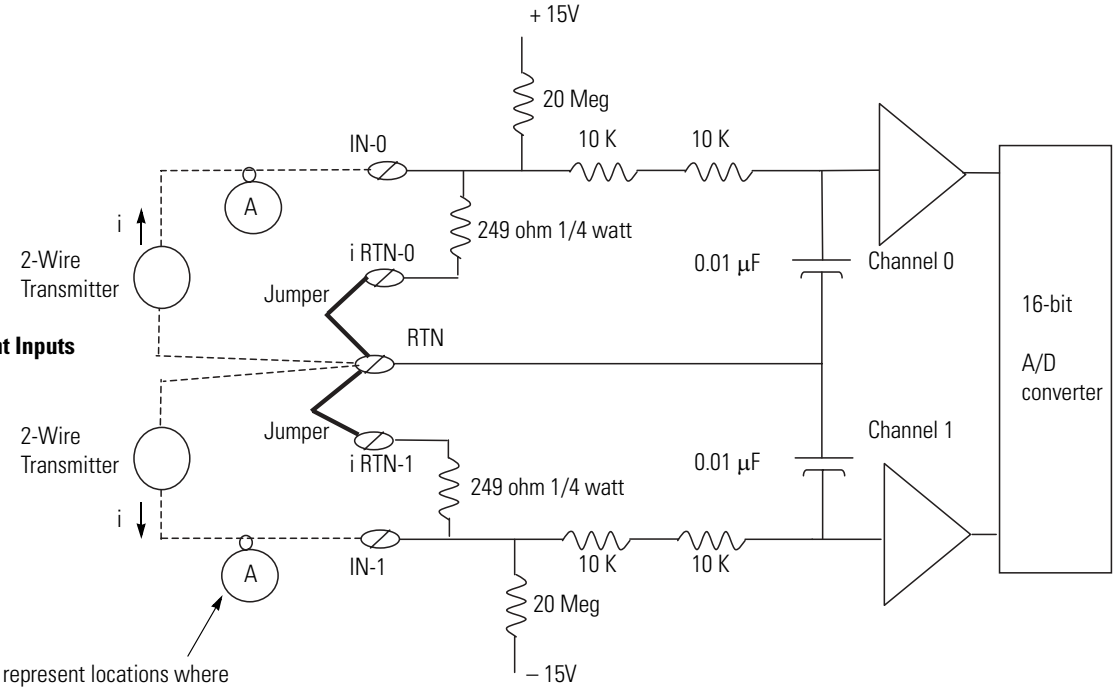


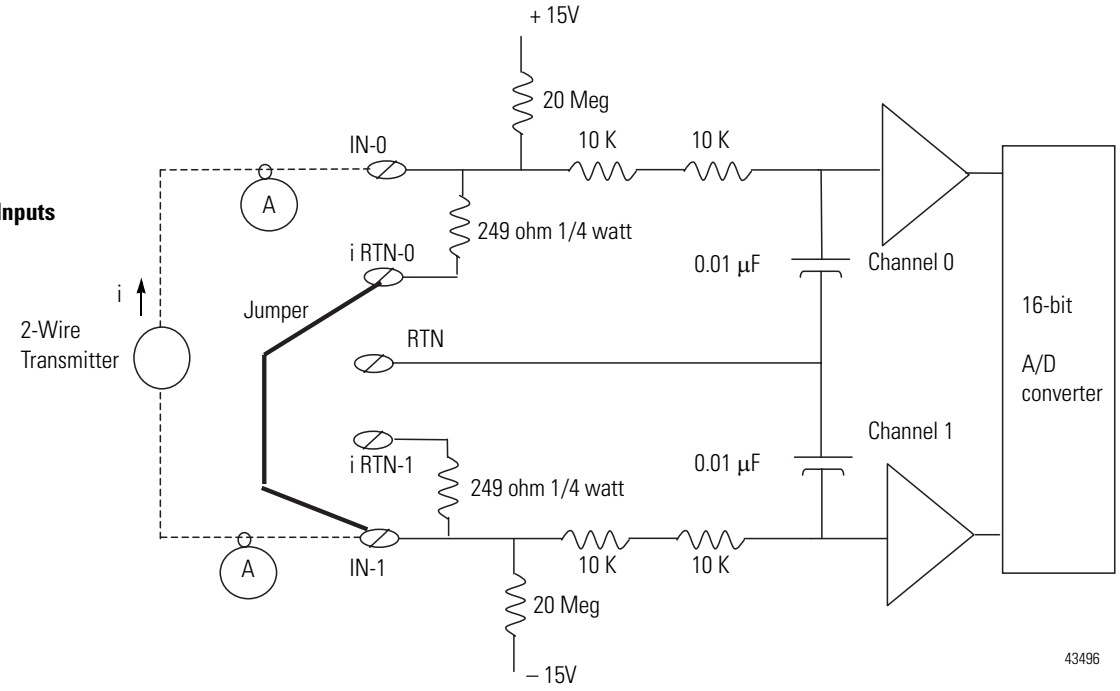
**Figure 4.6 1756-IF16 and 1756-IF8 Current Input Circuit**

**Single-Ended Current Inputs**



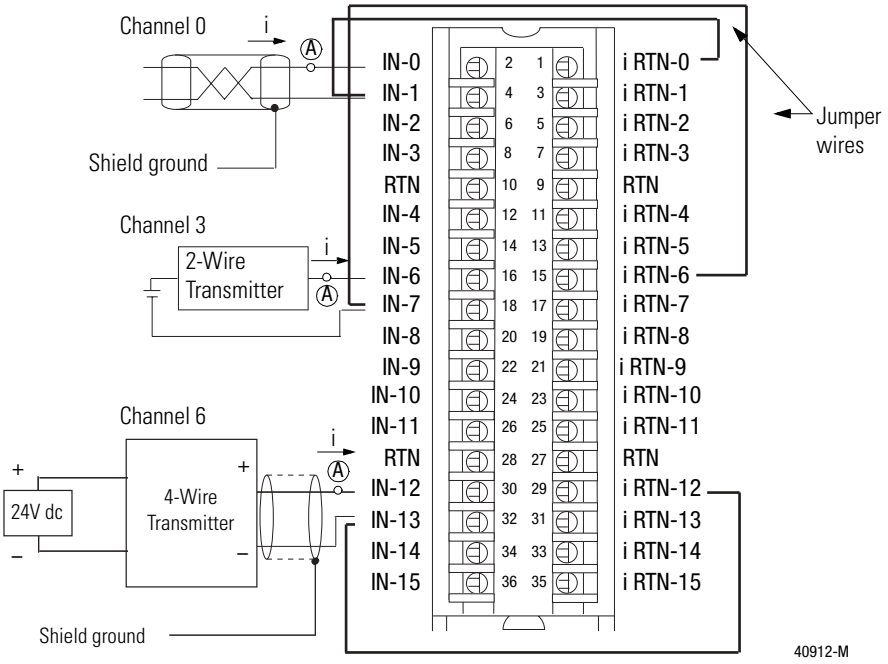

The A locations represent locations where you can place additional loop devices (e.g. strip chart recorders) in the current loop.

**Differential Current Inputs**



# Wiring the 1756-IF16 Module

**Figure 4.7 1756-IF16 Differential Current Wiring Example**




NOTES:

**1.** Use the Table D.8 when wiring your module in differential mode

**Table D.8**

| This channel: | Uses these terminals: | This channel: | Uses these terminals: |
|---|---|---|---|
| Channel 0 | IN-0 (+), IN-1 (-) & i RTN-0 | Channel 4 | IN-8 (+), IN-9 (-) & i RTN-8 |
| Channel 1 | IN-2 (+), IN-3 (-) & i RTN-2 | Channel 5 | IN-10 (+), IN-11 (-) & i RTN-10 |
| Channel 2 | IN-4 (+), IN-5 (-) & i RTN-4 | Channel 6 | IN-12 (+), IN-13 (-) & i RTN-12 |
| Channel 3 | IN-6 (+), IN-7 (-) & i RTN-6 | Channel 7 | IN-14 (+), IN-15 (-) & i RTN-14 |

**2.** All terminals marked RTN are connected internally.

**3.** A 249Ω current loop resistor is located between IN-x and i RTN-x terminals.

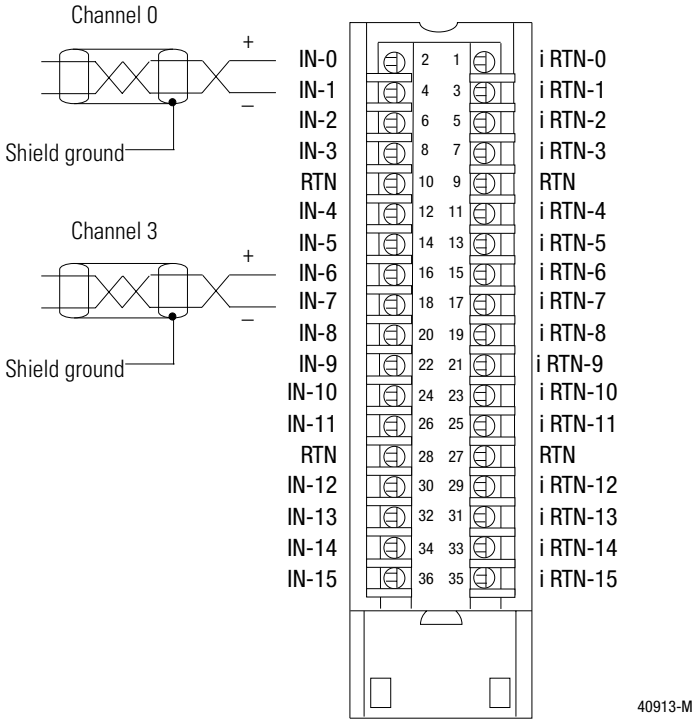
**4.** If multiple (+) or multiple (-) terminals are tied together, connect that tie point to a RTN terminal to maintain the module's accuracy.

**5.** Place additional loop devices (e.g. strip chart recorders, etc.) at the A location in the current loop.

**6.** Do not connect more than two wires to any single terminal.

**IMPORTANT**: When operating in 4 channel, **high speed mode**, only use channels 0, 2, 4 and 6.

**Figure 4.8 1756-IF16 Differential Voltage Wiring Example**




NOTES:

**1.** Use the Table D.9 when wiring your module in differential mode

**Table D.9**

| This channel: | Uses these terminals: | This channel: | Uses these terminals: |
|---|---|---|---|
| Channel 0 | IN-0 (+) & IN-1 (-) | Channel 4 | IN-8 (+) & IN-9 (-) |
| Channel 1 | IN-2 (+) & IN-3 (-) | Channel 5 | IN-10 (+) & IN-11 (-) |
| Channel 2 | IN-4 (+) & IN-5 (-) | Channel 6 | IN-12 (+) & IN-13 (-) |
| Channel 3 | IN-6 (+) & IN-7 (-) | Channel 7 | IN-14 (+) & IN-15 (-) |

**2.** All terminals marked RTN are connected internally.

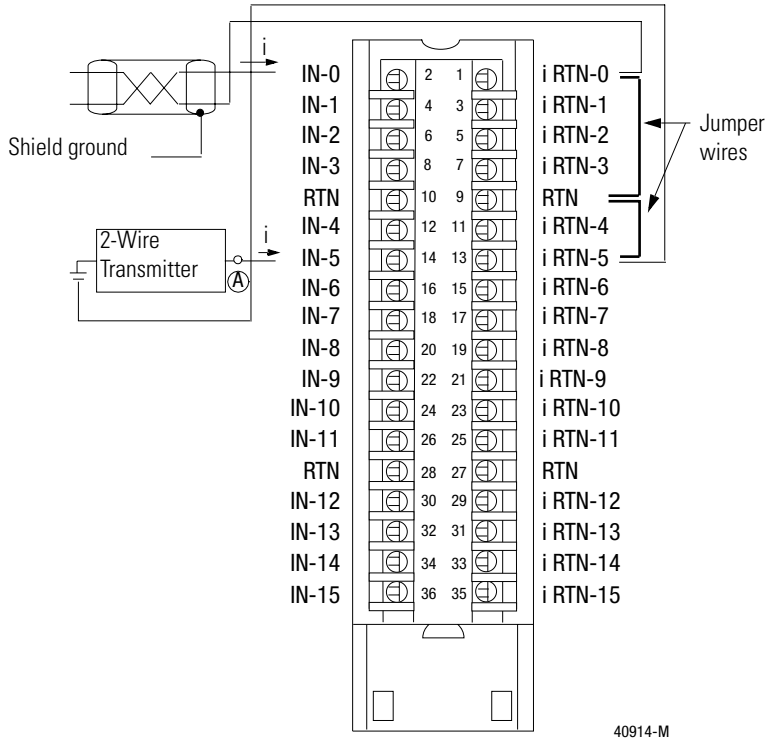
**3.** If multiple (+) or multiple (-) terminals are tied together, connect that tie point to a RTN terminal to maintain the module's accuracy.

**4.** Terminals marked RTN or iRTN are not used for differential voltage wiring.

**5.** Do not connect more than two wires to any single terminal.

**IMPORTANT**: When operating in 4 channel, **high speed mode**, only use channels 0, 2, 4 and 6.

**Figure 4.9 1756-IF16 Single-Ended Current Wiring Example**




NOTES:

**1.** All terminals marked RTN are connected internally.

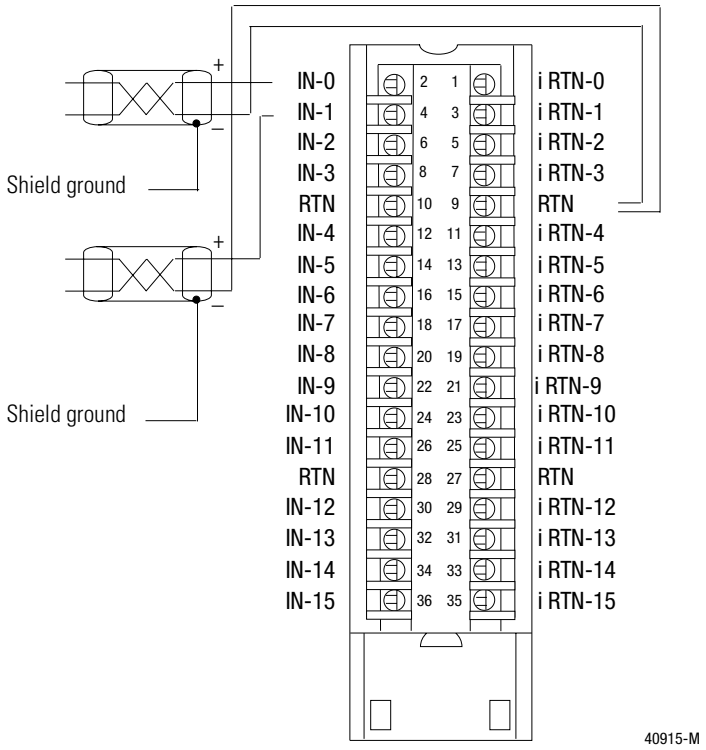
**2.** For current applications, all terminals marked iRTN must be wired to terminals marked RTN.

**3.** A 249Ω current loop resistor is located between IN-x and i RTN-x terminals.

**4.** Place additional loop devices (e.g. strip chart recorders, etc.) at the A location in the current loop.

**5.** Do not connect more than two wires to any single terminal.

**Figure 4.10 1756-IF16 Single-Ended Voltage Wiring Example**

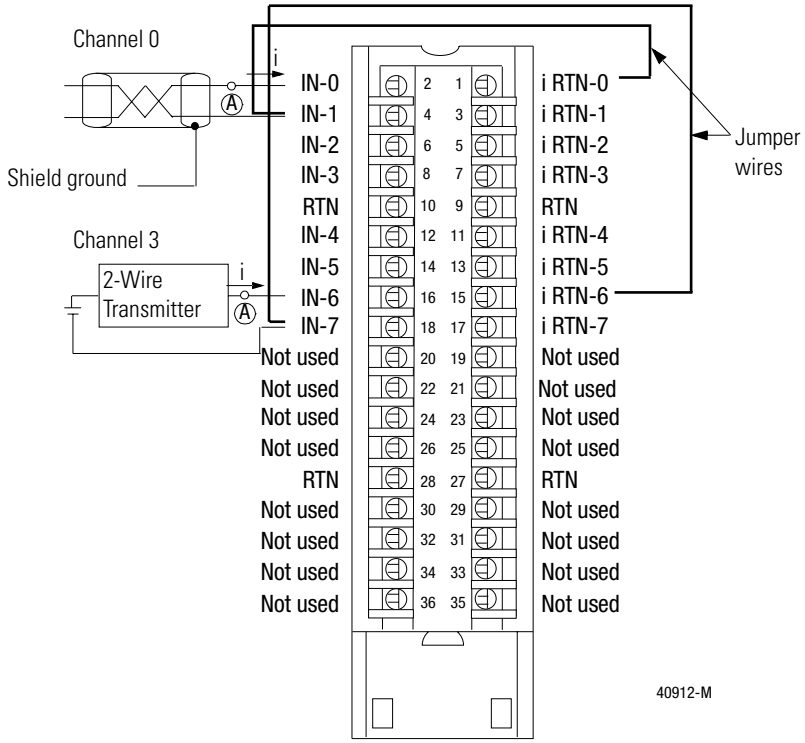



NOTES:

1. All terminals marked RTN are connected internally.
2. Terminals marked iRTN are not used for single-ended voltage wiring.
3. Do not connect more than two wires to any single terminal.

# Wiring the 1756-IF8 Module

**Figure 4.11 1756-IF8 Differential Current Wiring Example - 4 Channels**




NOTES:

1. Use the Table 4.10 when wiring your module in differential mode

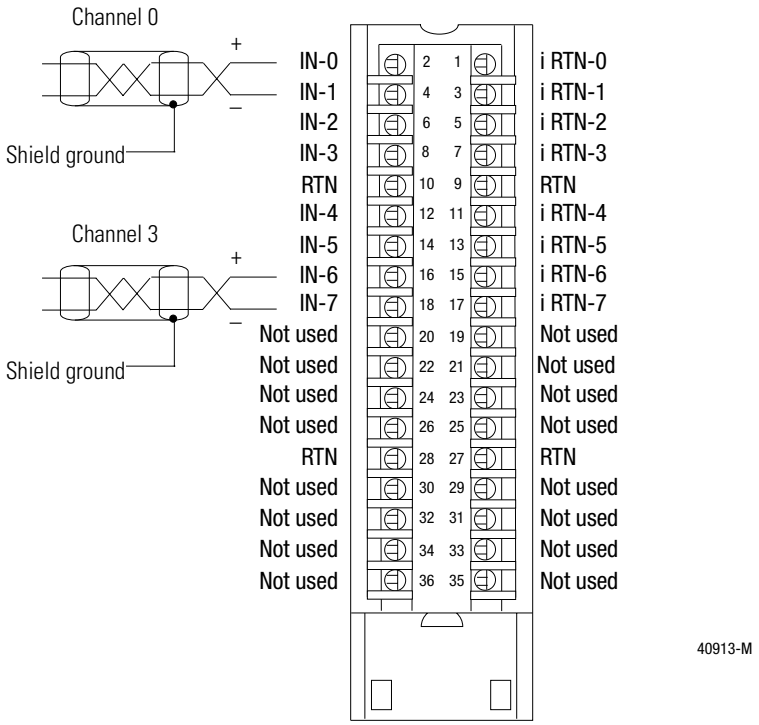
**Table 4.10**

| This channel: | Uses these terminals: |
|---|---|
| Channel 0 | IN-0 (+), IN-1 (-) & i RTN-0 |
| Channel 1 | IN-2 (+), IN-3 (-) & i RTN-2 |
| Channel 2 | IN-4 (+), IN-5 (-) & i RTN-4 |
| Channel 3 | IN-6 (+), IN-7 (-) & i RTN-6 |

2. All terminals marked RTN are connected internally.
3. A 249Ω current loop resistor is located between IN-x and i RTN-x terminals.
4. If multiple (+) or multiple (-) terminals are tied together, connect that tie point to a RTN terminal to maintain the module's accuracy.
5. Place additional loop devices (e.g. strip chart recorders, etc.) at the A location in the current loop.
6. Do not connect more than two wires to any single terminal.

**IMPORTANT**: When operating in 2 channel, **high speed mode**, only use channels 0 and 2.

**Figure 4.12 1756-IF8 Differential Voltage Wiring Example - 4 Channels**




NOTES:

**1.** Use the Table 4.11 when wiring your module in differential mode

**Table 4.11**

| This channel: | Uses these terminals: |
|---|---|
| Channel 0 | IN-0 (+) & IN-1 (-) |
| Channel 1 | IN-2 (+) & IN-3 (-) |
| Channel 2 | IN-4 (+) & IN-5 (-) |
| Channel 3 | IN-6 (+) & IN-7 (-) |

**2.** All terminals marked RTN are connected internally.

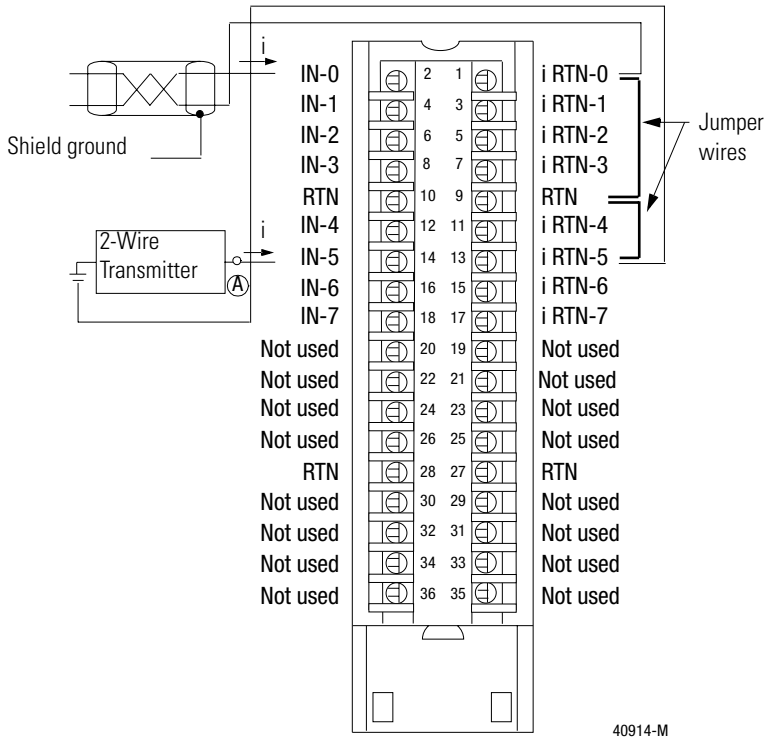
**3.** If multiple (+) or multiple (-) terminals are tied together, connect that tie point to a RTN terminal to maintain the module's accuracy.

**4.** Terminals marked RTN or iRTN are not used for differential voltage wiring.

**5.** Do not connect more than two wires to any single terminal.

**IMPORTANT**: When operating in 2 channel, **high speed mode**, only use channels 0 and 2.

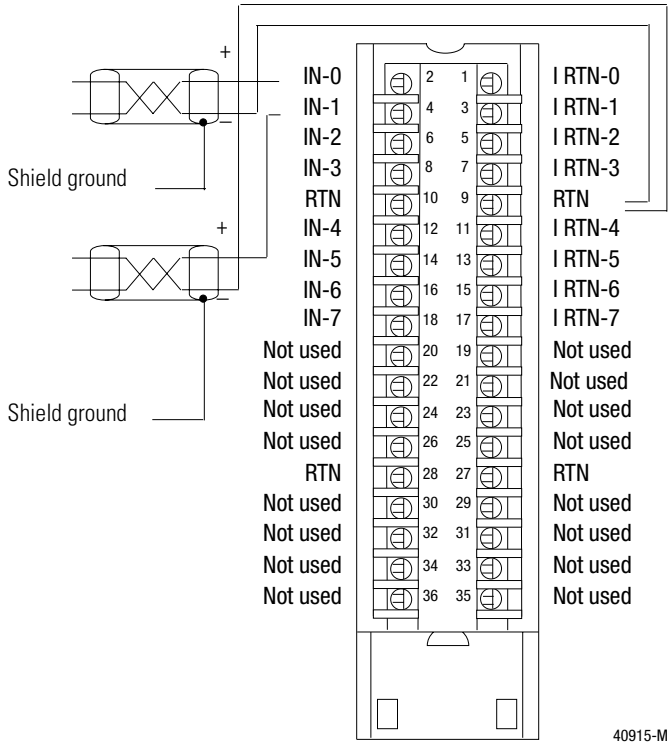
**Figure 4.13 1756-IF8 Single-Ended Current Wiring Example**




NOTES:

1. All terminals marked RTN are connected internally.
2. For current applications, all terminals marked iRTN must be wired to terminals marked RTN.
3. A 249Ω current loop resistor is located between IN-x and i RTN-x terminals.
4. Place additional loop devices (e.g. strip chart recorders, etc.) at the A location in the current loop.
5. Do not connect more than two wires to any single terminal.

**Figure 4.14 1756-IF8 Single-Ended Voltage Wiring Example**




NOTES:

1. All terminals marked RTN are connected internally.
2. Terminals marked iRTN are not used for single-ended voltage wiring.
3. Do not connect more than two wires to any single terminal.

## 1756-IF16 Module Fault and Status Reporting

The 1756-IF16 module multicasts status/fault data to the owner/listening controller with its channel data. The fault data is arranged in such a manner as to allow the user to choose the level of granularity he desires for examining fault conditions.

Three levels of tags work together to provide an increasing degree of detail as to the specific cause of faults on the module.

Table 4.12 lists tags that can be examined in ladder logic to indicate when a fault has occurred:

**Table 4.12**

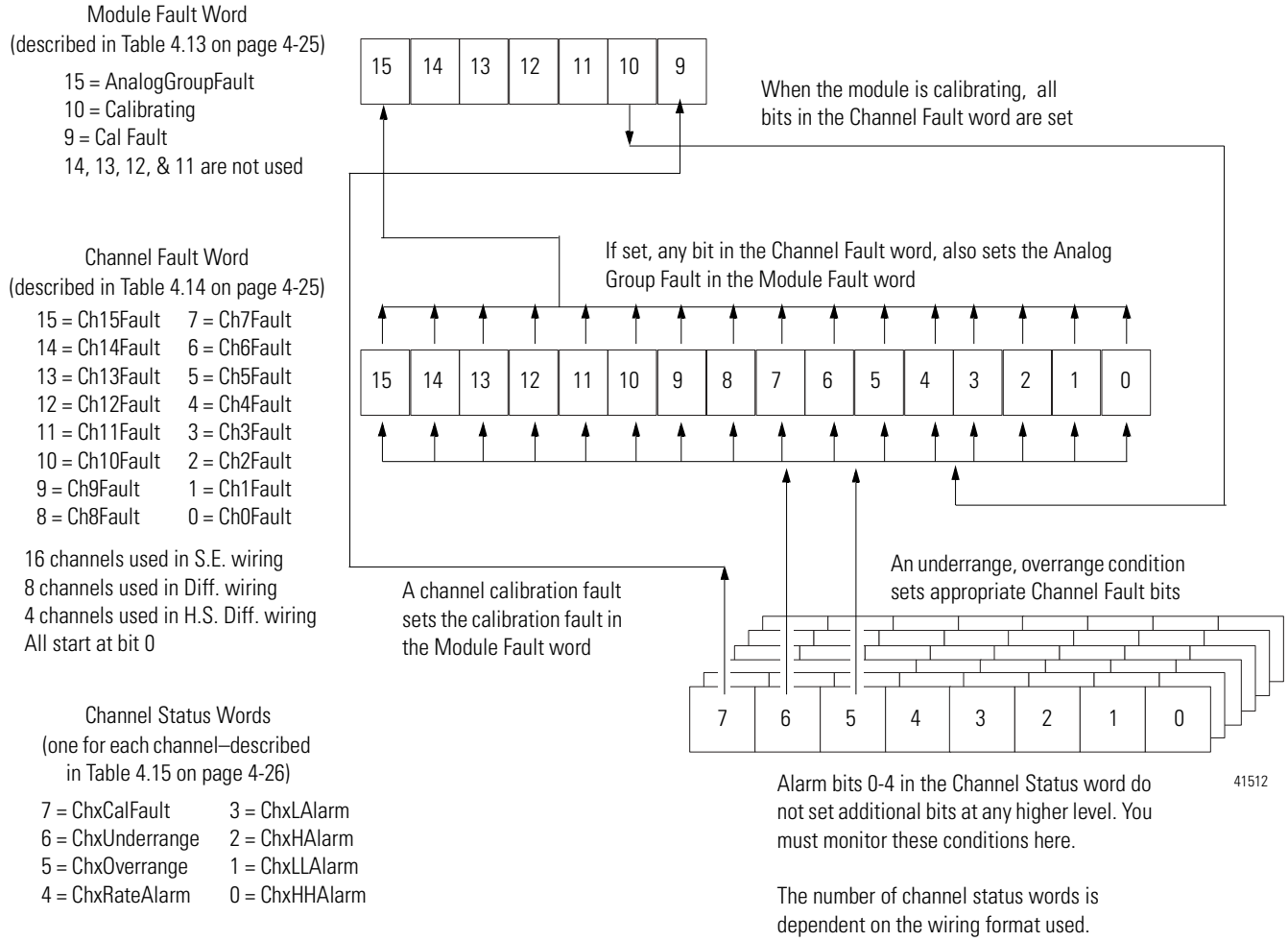
| Tag: | Description: |
|---|---|
| Module Fault Word | This word provides fault summary reporting. Its tag name is ModuleFaults. |
| Channel Fault Word | This word provides underrange, overrange and communications fault reporting. Its tag name is ChannelFaults. When examining the Channel Fault Word for faults, remember the following:<br>• 16 channels are used in single-ended wiring<br>• 8 channels are used in differential wiring<br>• 4 channels are used in high speed differential wiring<br>• All bytes start with bit 0 |
| Channel Status Words | These words, one per channel, provide individual channel underrange and overrange fault reporting for process alarms, rate alarms and calibration faults. Its tag name is ChxStatus. |

**IMPORTANT** Differences exist between floating point and integer modes as they relate to module fault reporting. These differences are explained in the following two sections.

# 1756-IF16 Fault Reporting in Floating Point Mode

Figure 4.15 an overview of the fault reporting process for the 1756-IF16 module in floating point mode.

**Figure 4.15**


Module Fault Word
(described in Table 4.13 on page 4-25)
15 = AnalogGroupFault
10 = Calibrating
9 = Cal Fault
14, 13, 12, & 11 are not used
15 14 13 12 11 10 9
When the module is calibrating, all bits in the Channel Fault word are set
Channel Fault Word
(described in Table 4.14 on page 4-25)
15 = Ch15Fault 7 = Ch7Fault
14 = Ch14Fault 6 = Ch6Fault
13 = Ch13Fault 5 = Ch5Fault
12 = Ch12Fault 4 = Ch4Fault
11 = Ch11Fault 3 = Ch3Fault
10 = Ch10Fault 2 = Ch2Fault
9 = Ch9Fault 1 = Ch1Fault
8 = Ch8Fault 0 = Ch0Fault
If set, any bit in the Channel Fault word, also sets the Analog Group Fault in the Module Fault word
15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
16 channels used in S.E. wiring
8 channels used in Diff. wiring
4 channels used in H.S. Diff. wiring
All start at bit 0
A channel calibration fault sets the calibration fault in the Module Fault word
An underrange, overrange condition sets appropriate Channel Fault bits
7 6 5 4 3 2 1 0
Channel Status Words
(one for each channel–described in Table 4.15 on page 4-26)
7 = ChxCalFault 3 = ChxLAlarm
6 = ChxUnderrange 2 = ChxHAlarm
5 = ChxOverrange 1 = ChxLLAlarm
4 = ChxRateAlarm 0 = ChxHHAlarm
41512
Alarm bits 0-4 in the Channel Status word do not set additional bits at any higher level. You must monitor these conditions here.
The number of channel status words is dependent on the wiring format used.

## 1756-IF16 Module Fault Word Bits – Floating Point Mode

Bits in this word provide the highest level of fault detection. A nonzero condition in this word reveals that a fault exists on the module. You can examine further down to isolate the fault.

Table 4.13 lists tags that can be examined in ladder logic to indicate when a fault has occurred:

**Table 4.13**

| Tag: | Description: |
|---|---|
| Analog Group Fault | This bit is set when any bits in the Channel Fault word are set. Its tag name is AnalogGroupFault. |
| Calibrating | This bit is set when any channel is being calibrated. When this bit is set, all bits in the Channel Fault word are set. Its tag name is Calibrating. |
| Calibration Fault | This bit is set when any of the individual Channel Calibration Fault bits are set. Its tag name is CalibrationFault. |

## 1756-IF16 Channel Fault Word Bits – Floating Point Mode

During normal module operation, bits in the Channel Fault word are set if any of the respective channels has an Under or Overrange condition. Checking this word for a nonzero value is a quick way to check for Under or Overrange conditions on the module.

Table 4.14 lists the conditions that set **all** Channel Fault word bits:

**Table 4.14**

| This condition sets all Channel Fault word bits: | And causes the module to display the following in the Channel Fault word bits: |
|---|---|
| A channel is being calibrated | • "FFFF" for single-ended operating mode<br>• "00FF" for differential operating mode<br>• "000F" for high speed differential operating mode |
| A communications fault occurred between the module and its owner-controller | "FFFF" for all bits, regardless of the application |

Your logic can monitor the Channel Fault Word bit for a particular input to determine the state of that point.

## 1756-IF16 Channel Status Word Bits – Floating Point Mode

Any of the Channel Status words, one for each channel, display a nonzero condition if that particular channel has faulted for the conditions listed below. Some of these bits set bits in other Fault words. When the Underrange or Overrange bits (bits 6 & 5) in any of the words are set, the appropriate bit is set in the Channel Fault word.

When the Calibration Fault bit (bit 7) is set in any of the words, the Calibration Fault bit (bit 9) is set in the Module Fault word. Table 4.15 lists the conditions that set each of the word bits.

**Table 4.15**

| Tag (Status word): | Bit: | Event that sets this tag: |
|---|---|---|
| ChxCalFault | Bit 7 | This bit is set if an error occurs during calibration for that channel, causing a bad calibration. This bit also sets bit 9 in the Module Fault word. |
| Underrange | Bit 6 | This bit is set when the input signal at the channel is less than or equal to the minimum detectable signal. For more information on the minimum detectable signal for each module, see Table 4.6 on page 4-7. This bit also sets the appropriate bit in the Channel Fault word. |
| Overrange | Bit 5 | This bit is set when the input signal at the channel is greater than or equal to the maximum detectable signal. For more information on the maximum detectable signal for each module, see Table 4.6 on page 4-7. This bit also sets the appropriate bit in the Channel Fault word. |
| ChxRateAlarm | Bit 4(1) | This bit is set when the input channel's rate of change exceeds the configured Rate Alarm parameter. It remains set until the rate of change drops below the configured rate. If latched, the alarm will remain set until it is unlatched. |
| ChxLAlarm | Blt 3(1) | This bit is set when the input signal moves beneath the configured Low Alarm limit. It remains set until the signal moves above the configured trigger point. If latched, the alarm will remain set until it is unlatched. If a deadband is specified, the alarm will also remain set as long as the signal remains within the configured deadband. |
| ChxHAlarm | Bit 2(1) | This bit is set when the input signal moves above the configured High Alarm limit. It remains set until the signal moves below the configured trigger point. If latched, the alarm will remain set until it is unlatched. If a deadband is specified, the alarm will also remain set as long as the signal remains within the configured deadband. |
| ChxLLAlarm | Bit 1(1) | This bit is set when the input signal moves beneath the configured Low-Low Alarm limit. It remains set until the signal moves above the configured trigger point. If latched, the alarm will remain set until it is unlatched. If a deadband is specified, the alarm will also remain latched as long as the signal remains within the configured deadband. |
| ChxHHAlarm | Bit 0(1) | This bit is set when the input signal moves above the configured High-High Alarm limit. It remains set until the signal moves below the configured trigger point. If latched, the alarm will remain set until it is unlatched. If a deadband is specified, the alarm will also remain latched as long as the signal remains within the configured deadband. |

(1) Bits 0-4 are **not available** in floating point single-ended mode.

# 1756-IF16 Fault Reporting in Integer Mode

The following graphic provides an overview of the fault reporting process for the 1756-IF16 module in integer mode.

**Figure 4.16**

Module Fault Word
(described in Table 4.16 on page 4-28)

15 = AnalogGroupFault
10 = Calibrating
9 = Cal Fault
14, 13, 12, & 11 are not used

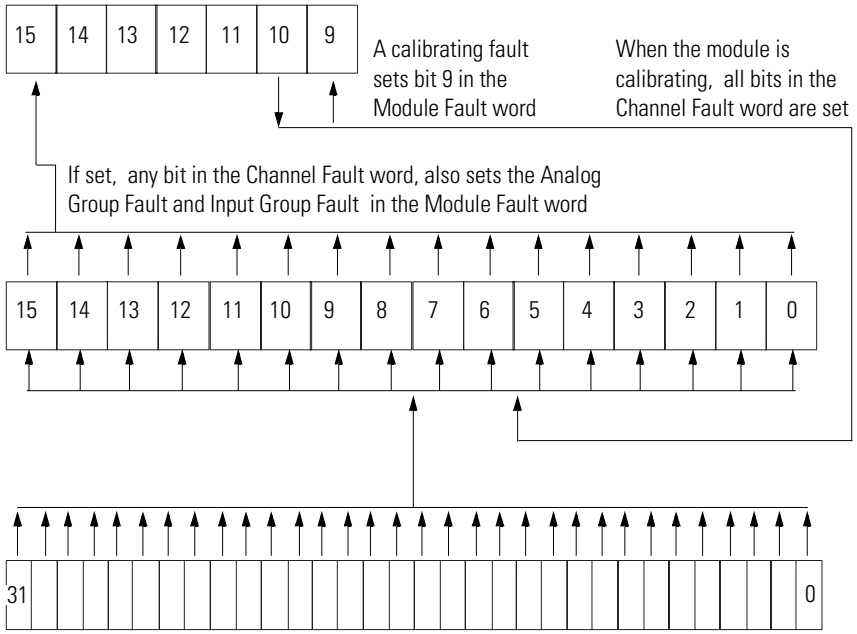
Channel Fault Word
(described in Table 4.17 on page 4-28)

15 = Ch15Fault 7 = Ch7Fault
14 = Ch14Fault 6 = Ch6Fault
13 = Ch13Fault 5 = Ch5Fault
12 = Ch12Fault 4 = Ch4Fault
11 = Ch11Fault 3 = Ch3Fault
10 = Ch10Fault 2 = Ch2Fault
9 = Ch9Fault 1 = Ch1Fault
8 = Ch8Fault 0 = Ch0Fault
16 channels used in S.E. wiring
8 channels used in Diff. wiring
4 channels used in H.S. Diff. wiring
All start at bit 0

Channel Status Words
(described in Table 4.18 on page 4-29)

31 = Ch0Underrange 23 = Ch4Underrange 15 = Ch8Underrange 7 = Ch12Underrange
30 = Ch0Overrange 22 = Ch4Overrange 14 = Ch8Overrange 6 = Ch12Overrange
29 = Ch1Underrange 21 = Ch5Underrange 13 = Ch9Underrange 5 = Ch13Underrange
28 = Ch1Overrange 20 = Ch5Overrange 12 = Ch9Overrange 4 = Ch13Overrange
27 = Ch2Underrange 19 = Ch6Underrange 11 = Ch10Underrange 3 = Ch14Underrange
26 = Ch2Overrange 18 = Ch6Overrange 10 = Ch10verrange 2 = Ch14Overrange
25 = Ch3Underrange 17 = Ch7Underrange 9 = C11Underrange 1 = Ch15Underrange
24 = Ch3Overrange 16 = Ch7Overrange 8 = Ch11Overrange 0 = Ch15Overrange

16 channels used in S.E. wiring
8 channels used in Diff. wiring
4 channels used in H.S. Diff. wiring
All start at bit 31


15 14 13 12 11 10 9
A calibrating fault sets bit 9 in the Module Fault word
When the module is calibrating, all bits in the Channel Fault word are set
If set, any bit in the Channel Fault word, also sets the Analog Group Fault and Input Group Fault in the Module Fault word
15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
31
0
Underrange and overrange conditions set the corresponding Channel Fault word bit for that channel
41513

## 1756-IF16 Module Fault Word Bits – Integer Mode

In integer mode, Module Fault word bits (bits 15-8) operate exactly as described in floating point mode. Table 4.16 lists tags that can be examined in ladder logic to indicate when a fault has occurred:

**Table 4.16**

| Tag: | Description: |
|---|---|
| Analog Group Fault | This bit is set when any bits in the Channel Fault word are set. Its tag name is AnalogGroupFault. |
| Calibrating | This bit is set when any channel is being calibrated. When this bit is set, all bits in the Channel Fault word are set. Its tag name is Calibrating. |
| Calibration Fault | This bit is set when any of the individual Channel Calibration Fault bits are set. Its tag name is CalibrationFault. |

## 1756-IF16 Channel Fault Word Bits – Integer Mode

In integer mode, Channel Fault word bits operate exactly as described in floating point mode. Table 4.17 lists the conditions that set **all** Channel Fault word bits:

**Table 4.17**

| This condition sets all Channel Fault word bits: | And causes the module to display the following in the Channel Fault word bits: |
|---|---|
| A channel is being calibrated | • "FFFF" for single-ended operating mode<br>• "00FF" for differential operating mode<br>• "000F" for high speed differential operating mode |
| A communications fault occurred between the module and its owner-controller | "FFFF" for all bits, regardless of the application |

Your logic can monitor the Channel Fault Word bit for a particular input to determine the state of that point.

## 1756-IF16 Channel Status Word Bits – Integer Mode

The Channel Status word has the following differences when the 1756-IF16 module is used in integer mode:

- Only Underrange and Overrange conditions are reported by the module.
- Alarming and Calibration Fault activities are not available, although the Calibration Fault bit in the Module Fault word activates if a channel is not properly calibrated.
- There is one 32 bit Channel Status word for all 16 channels.

When the Calibration Fault bit (bit 7) is set in any of the words, the Calibration Fault bit (bit 9) is set in the Module Fault word. Table 4.18 lists the conditions that set each of the words.

**Table 4.18**

| Tag (Status word): | Bit: | Event that sets this tag: |
|---|---|---|
| ChxUnderrange | Odd-numbered bits from bit 31 to bit 1 (e.g. bit 31 represents channel 0).<br><br>For a full listing of the channels these bits represent, see Figure 4.16 on page 4-27. | The underrange bit is set when the input signal at the channel is less than or equal to the minimum detectable signal.<br><br>For more information on the minimum detectable signal for each module, see Table 4.6 on page 4-7. This bit also sets the appropriate bit in the Channel Fault word. |
| ChxOverrange | Even-numbered bits from bit 30 to bit 0 (e.g. bit 30 represents channel 0).<br><br>For a full listing of the channels these bits represent, see Figure 4.16 on page 4-27. | The overrange bit is set when the input signal at the channel is greater than or equal to the maximum detectable signal.<br><br>For more information on the maximum detectable signal for each module, see Table 4.6 on page 4-7. This bit also sets the appropriate bit in the Channel Fault word. |

## 1756-IF8 Module Fault and Status Reporting

The 1756-IF8 module multicasts status/fault data to the owner/listening controller with its channel data. The fault data is arranged in such a manner as to allow the user to choose the level of granularity he desires for examining fault conditions.

Three levels of tags work together to provide an increasing degree of detail as to the specific cause of faults on the module.

Table 4.19 lists tags that can be examined in ladder logic to indicate when a fault has occurred:

**Table 4.19**

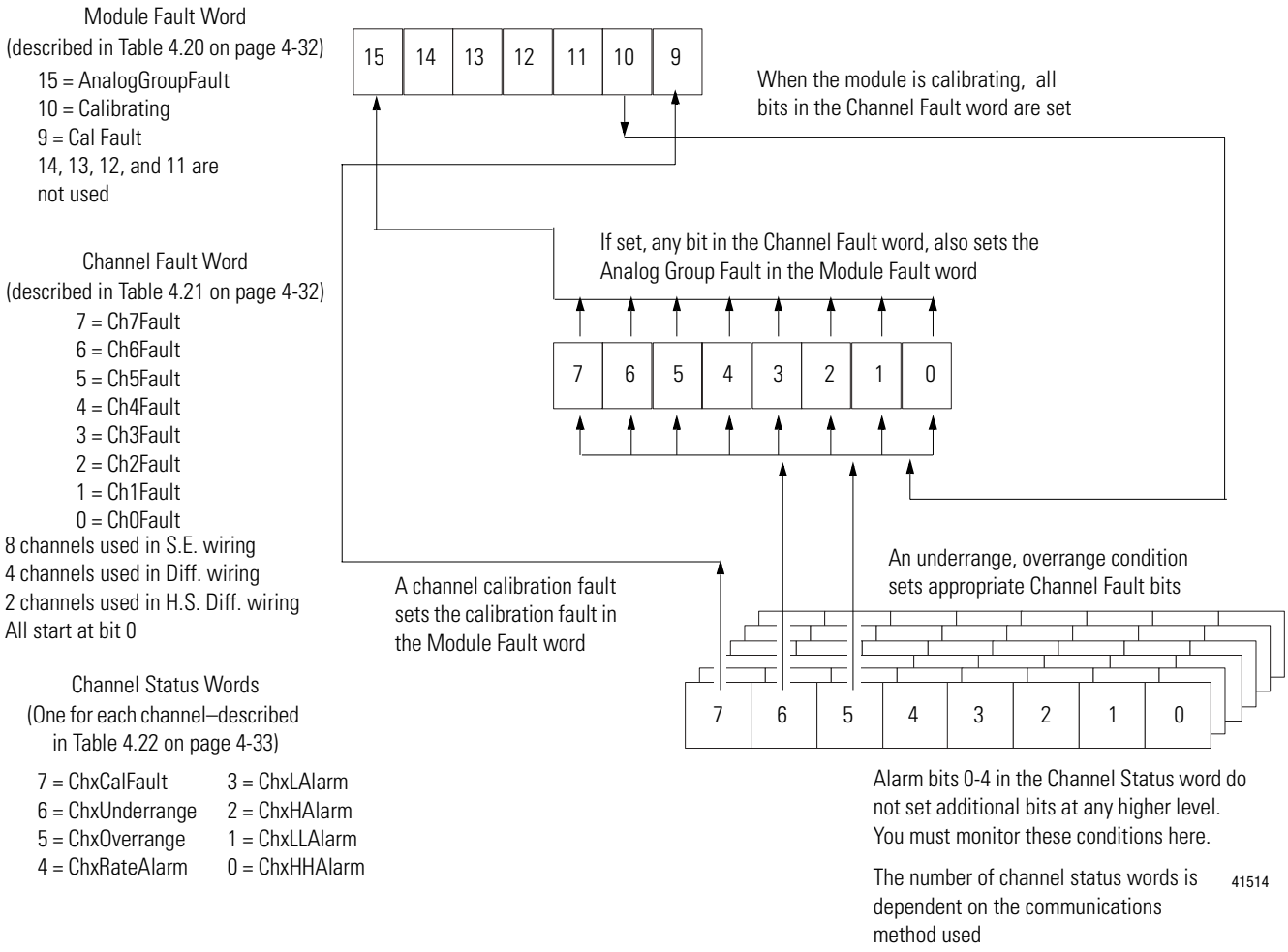
| Tag: | Description: |
|---|---|
| Module Fault Word | This word provides fault summary reporting. Its tag name is ModuleFaults. |
| Channel Fault Word | This word provides underrange, overrange and communications fault reporting. Its tag name is ChannelFaults. When examining the Channel Fault Word for faults, remember the following:<br>• 8 channels are used in single-ended wiring<br>• 4 channels are used in differential wiring<br>• 2 channels are used in high speed differential wiring<br>• All bytes start with bit 0 |
| Channel Status Words | These words, one per channel, provide individual channel underrange and overrange fault reporting for process alarms, rate alarms and calibration faults. Its tag name is ChxStatus. |

**IMPORTANT** Differences exist between floating point and integer modes as they relate to module fault reporting. These differences are explained in the following two sections.

## 1756-IF8 Fault Reporting in Floating Point Mode

Figure 4.17 offers an overview of the fault reporting process for the 1756-IF8 module in floating point mode.

**Figure 4.17**


Module Fault Word
(described in Table 4.20 on page 4-32)
15 = AnalogGroupFault
10 = Calibrating
9 = Cal Fault
14, 13, 12, and 11 are not used
15 14 13 12 11 10 9
When the module is calibrating, all bits in the Channel Fault word are set
If set, any bit in the Channel Fault word, also sets the Analog Group Fault in the Module Fault word
Channel Fault Word
(described in Table 4.21 on page 4-32)
7 = Ch7Fault
6 = Ch6Fault
5 = Ch5Fault
4 = Ch4Fault
3 = Ch3Fault
2 = Ch2Fault
1 = Ch1Fault
0 = Ch0Fault
8 channels used in S.E. wiring
4 channels used in Diff. wiring
2 channels used in H.S. Diff. wiring
All start at bit 0
7 6 5 4 3 2 1 0
A channel calibration fault sets the calibration fault in the Module Fault word
An underrange, overrange condition sets appropriate Channel Fault bits
7 6 5 4 3 2 1 0
Channel Status Words
(One for each channel–described in Table 4.22 on page 4-33)
7 = ChxCalFault
6 = ChxUnderrange
5 = ChxOverrange
4 = ChxRateAlarm
3 = ChxLAlarm
2 = ChxHAlarm
1 = ChxLLAlarm
0 = ChxHHAlarm
Alarm bits 0-4 in the Channel Status word do not set additional bits at any higher level. You must monitor these conditions here.
The number of channel status words is dependent on the communications method used
41514

## 1756-IF8 Module Fault Word Bits – Floating Point Mode

Bits in this word provide the highest level of fault detection. A nonzero condition in this word reveals that a fault exists on the module. You can examine further down to isolate the fault.

Table 4.20 lists tags that can be examined in ladder logic to indicate when a fault has occurred:

**Table 4.20**

| Tag: | Description: |
|---|---|
| Analog Group Fault | This bit is set when any bits in the Channel Fault word are set. Its tag name is AnalogGroupFault. |
| Calibrating | This bit is set when any channel is being calibrated. When this bit is set, all bits in the Channel Fault word are set. Its tag name is Calibrating. |
| Calibration Fault | This bit is set when any of the individual Channel Calibration Fault bits are set. Its tag name is CalibrationFault. |

## 1756-IF8 Channel Fault Word Bits – Floating Point Mode

During normal module operation, bits in the Channel Fault word are set if any of the respective channels has an Under or Overrange condition. Checking this word for a nonzero value is a quick way to check for Under or Overrange conditions on the module.

Table 4.21 lists the conditions that set **all** Channel Fault word bits:

**Table 4.21**

| This condition sets all Channel Fault word bits: | And causes the module to display the following in the Channel Fault word bits: |
|---|---|
| A channel is being calibrated | • "00FF" for single-ended wiring applications<br>• "000F" for differential wiring applications<br>• "0003" for high speed differential wiring applications |
| A communications fault occurred between the module and its owner-controller | "FFFF" for all bits, regardless of the application |

Your logic can monitor the Channel Fault Word bit for a particular input to determine the state of that point.

## 1756-IF8 Channel Status Word Bits – Floating Point Mode

Any of the Channel Status words, one for each channel, will display a nonzero condition if that particular channel has faulted for the conditions listed below. Some of these bits set bits in other Fault words. When the Underrange and Overrange bits (bits 6 & 5) in any of the words are set, the appropriate bit is set in the Channel Fault word.

When the Calibration Fault bit (bit 7) is set in any of the words, the Calibration Fault bit (bit 9) is set in the Module Fault word. Table 4.22 lists the conditions that set each of the word bits.

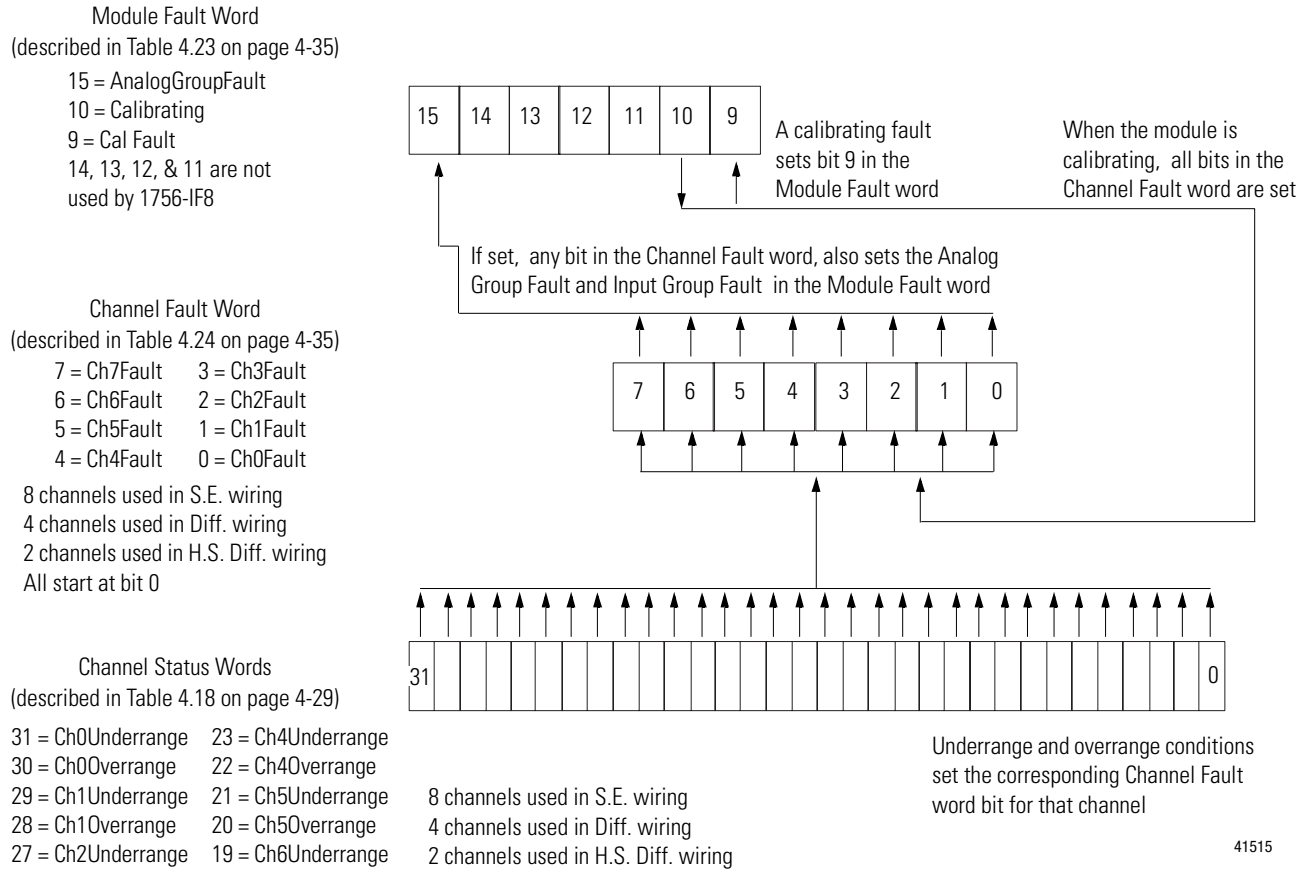
**Table 4.22**

| Tag (Status word): | Bit: | Event that sets this tag: |
|---|---|---|
| ChxCalFault | Bit 7 | This bit is set if an error occurs during calibration for that channel, causing a bad calibration. This bit also sets bit 9 in the Module Fault word. |
| Underrange | Bit 6 | This bit is set when the input signal at the channel is less than or equal to the minimum detectable signal. For more information on the minimum detectable signal for each module, see Table 4.6 on page 4-7. This bit also sets the appropriate bit in the Channel Fault word. |
| Overrange | Bit 5 | This bit is set when the input signal at the channel is greater than or equal to the maximum detectable signal. For more information on the maximum detectable signal for each module, see Table 4.6 on page 4-7. This bit also sets the appropriate bit in the Channel Fault word. |
| ChxRateAlarm | Bit 4 | This bit is set when the input channel's rate of change exceeds the configured Rate Alarm parameter. It remains set until the rate of change drops below the configured rate. If latched, the alarm will remain set until it is unlatched. |
| ChxLAlarm | Blt 3 | This bit is set when the input signal moves beneath the configured Low Alarm limit. It remains set until the signal moves above the configured trigger point. If latched, the alarm will remain set until it is unlatched. If a deadband is specified, the alarm will also remain set as long as the signal remains within the configured deadband. |
| ChxHAlarm | Bit 2 | This bit is set when the input signal moves above the configured High Alarm limit. It remains set until the signal moves below the configured trigger point. If latched, the alarm will remain set until it is unlatched. If a deadband is specified, the alarm will also remain set as long as the signal remains within the configured deadband. |
| ChxLLAlarm | Bit 1 | This bit is set when the input signal moves beneath the configured Low-Low Alarm limit. It remains set until the signal moves above the configured trigger point. If latched, the alarm will remain set until it is unlatched. If a deadband is specified, the alarm will also remain latched as long as the signal remains within the configured deadband. |
| ChxHHAlarm | Bit 0 | This bit is set when the input signal moves above the configured High-High Alarm limit. It remains set until the signal moves below the configured trigger point. If latched, the alarm will remain set until it is unlatched. If a deadband is specified, the alarm will also remain latched as long as the signal remains within the configured deadband. |

## 1756-IF8 Fault Reporting in Integer Mode

Figure 4.18 offers an overview of the fault reporting process for the 1756-IF8 module in integer mode.

**Figure 4.18**


Module Fault Word
(described in Table 4.23 on page 4-35)
15 = AnalogGroupFault
10 = Calibrating
9 = Cal Fault
14, 13, 12, & 11 are not used by 1756-IF8
15 14 13 12 11 10 9
A calibrating fault sets bit 9 in the Module Fault word
When the module is calibrating, all bits in the Channel Fault word are set
If set, any bit in the Channel Fault word, also sets the Analog Group Fault and Input Group Fault in the Module Fault word
Channel Fault Word
(described in Table 4.24 on page 4-35)
7 = Ch7Fault 3 = Ch3Fault
6 = Ch6Fault 2 = Ch2Fault
5 = Ch5Fault 1 = Ch1Fault
4 = Ch4Fault 0 = Ch0Fault
8 channels used in S.E. wiring
4 channels used in Diff. wiring
2 channels used in H.S. Diff. wiring
All start at bit 0
7 6 5 4 3 2 1 0
Channel Status Words
(described in Table 4.18 on page 4-29)
31 = Ch0Underrange 23 = Ch4Underrange
30 = Ch0Overrange 22 = Ch4Overrange
29 = Ch1Underrange 21 = Ch5Underrange
28 = Ch1Overrange 20 = Ch5Overrange
27 = Ch2Underrange 19 = Ch6Underrange
26 = Ch2Overrange 18 = Ch6Overrange
25 = Ch3Underrange 17 = Ch7Underrange
24 = Ch3Overrange 16 = Ch7Overrange
31 0
8 channels used in S.E. wiring
4 channels used in Diff. wiring
2 channels used in H.S. Diff. wiring
All start at bit 31
Underrange and overrange conditions set the corresponding Channel Fault word bit for that channel
41515

## 1756-IF8 Module Fault Word Bits – Integer Mode

In integer mode, Module Fault word bits (bits 15-8) operate exactly as described in floating point mode. Table 4.23 lists tags that can be examined in ladder logic to indicate when a fault has occurred:

**Table 4.23**

| Tag: | Description: |
|---|---|
| Analog Group Fault | This bit is set when any bits in the Channel Fault word are set. Its tag name is AnalogGroupFault. |
| Calibrating | This bit is set when any channel is being calibrated. When this bit is set, all bits in the Channel Fault word are set. Its tag name is Calibrating. |
| Calibration Fault | This bit is set when any of the individual Channel Calibration Fault bits are set. Its tag name is CalibrationFault. |

## 1756-IF8 Channel Fault Word Bits – Integer Mode

In integer mode, Channel Fault word bits operate exactly as described in floating point mode. Table 4.24 lists the conditions that set **all** Channel Fault word bits:

**Table 4.24**

| This condition sets all Channel Fault word bits: | And causes the module to display the following in the Channel Fault word bits: |
|---|---|
| A channel is being calibrated | • "00FF" for single-ended wiring applications<br>• "000F" for differential wiring applications<br>• "0003" for high speed differential wiring applications |
| A communications fault occurred between the module and its owner-controller | "FFFF" for all bits, regardless of the application |

### 1756-IF8 Channel Status Word Bits – Integer Mode

The Channel Status word has the following differences when the 1756-IF16 module is used in integer mode:

- Only Underrange and Overrange conditions are reported by the module.
- Alarming and Calibration Fault activities are not available, although the Calibration Fault bit in the Module Fault word activates if a channel is not properly calibrated.
- There is one 32 bit Channel Status word for all 8 channels.

When the Calibration Fault bit (bit 7) is set in any of the words, the Calibration Fault bit (bit 9) is set in the Module Fault word. Table 4.25 lists the conditions that set each of the words.

**Table 4.25**

| Tag (Status word): | Bit: | Event that sets this tag: |
|---|---|---|
| ChxUnderrange | Odd-numbered bits from bit 31 to bit 1 (e.g. bit 31 represents channel 17).<br><br>For a full listing of the channels these bits represent, see Figure 4.18 on page 4-34. | The underrange bit is set when the input signal at the channel is less than or equal to the minimum detectable signal.<br><br>For more information on the minimum detectable signal for each module, see Table 4.6 on page 4-7. This bit also sets the appropriate bit in the Channel Fault word. |
| ChxOverrange | Even-numbered bits from bit 30 to bit 16 (e.g. bit 30 represents channel 0).<br><br>For a full listing of the channels these bits represent, see Figure 4.18 on page 4-34. | The overrange bit is set when the input signal at the channel is greater than or equal to the maximum detectable signal.<br><br>For more information on the maximum detectable signal for each module, see Table 4.6 on page 4-7. This bit also sets the appropriate bit in the Channel Fault word. |

## Chapter Summary and What's Next

In this chapter you read about the Non-Isolated Analog Voltage/Current Input Modules (1756-IF16, -IF8).

Chapter 5 describes features specific to the Sourcing Current Loop Input Module (1756-IF6CIS) and Isolated Analog Voltage/Current Input Module (1756-IF6I).

# Sourcing Current Loop Input Module (1756-IF6CIS) and Isolated Analog Voltage/Current Input Module (1756-IF6I)

## What This Chapter Contains

This chapter describes features specific to ControlLogix isolated analog voltage/current input module and the ControlLogix sourcing current loop input module.


| For information about: | See page: |
|---|---|
| Using the Isolated Power Source on the 1756-IF6CIS | 5-2 |
| Choosing a Data Format | 5-4 |
| Features Specific to the 1756-IF6I and 1756-IF6CIS Modules | 5-4 |
| Using Module Block and Input Circuit Diagrams | 5-12 |
| Wiring the 1756-IF6CIS Module | 5-14 |
| Wiring the 1756-IF6I Module | 5-17 |
| 1756-IF6CIS or 1756-IF6I Module Fault and Status Reporting | 5-19 |


**IMPORTANT**

The 1756-IF6CIS and 1756-IF6I modules primarily operate the same with a few exceptions, including:

- The 1756-IF6CIS only operates in current mode
- The 1756-IF6CIS offers an isolated power source for each channel that supplies power to external transmitters

The differences on the 1756-IF6CIS module are described on page 5-2.

With a few noted exceptions included in the descriptions, the rest of the features described in this chapter apply to both modules.

## Using the Isolated Power Source on the 1756-IF6CIS

The 1756-IF6CIS module offers an internal power source on each channel. The source is current limited to 28mA and allows the module to power a two-wire transmitter directly without the need for an external power supply. The transmitter can then vary the current to the analog input in proportion to the process variable being measured. The inclusion of an internal an on-board current source, saves you the expense of extra power supplies and greatly simplifies the interface wiring to field devices.

In addition to supplying loop power to 2-wire transmitters, the module can also acomodate current loops powered by an external supply and loops using 4-wire transmitters.

### *Power Calculations with the 1756-IF6CIS Module*

The 1756-IF6CIS module uses the system power supply (1756-Px7x) as the source for loop power. Because of the demands placed on that supply (e.g. the 1756-IF6CIS module consumes 7.9W of backplane power), special care must be taken when calculating the power requirements for modules in the same chassis as a 1756-IF6CIS module.

For example, when used with the 1756-L55M13 controller, you can place only 8 1756-IF6CIS modules in the chassis before exceeding the wattage capacity of the power supply.

### *Including Other Devices in the Wiring Loop*

The voltage source on each channel can drive loop impedance of up to 1000 ohms. This allows you to include other devices, such as chart recorders and meters, in the current loop.

For more information on wiring the 1756-IF6CIS module, see page 5-14.

The 1756-IF6CIS and 1756-IF6I modules also support features described in Chapter 3. Table 5.1 lists those additional features.

**Table 5.1 Additional Features Supported by the 1756-IF6CIS and 1756-IF6I Modules**

| Feature: | Page of description: |
|---|---|
| Removal and Insertion Under Power (RIUP) | 3-2 |
| Module Fault Reporting | 3-3 |
| Fully Software Configurable | 3-3 |
| Electronic Keying | 3-4 |
| Access to System Clock for Timestamping Functions | 3-6 |
| Rolling Timestamp | 3-6 |
| Producer/Consumer Model | 3-6 |
| Status Indicator Information | 3-7 |
| Full Class I Division 2 Compliance | 3-7 |
| UL, CSA, FM, CE, C-Tick, EEx, TUV Agency Certification | 3-7 |
| Field Calibration | 3-8 |
| Sensor Offset | 3-8 |
| Latching of Alarms | 3-8 |

## Choosing a Data Format

Data format determines the format of the data returned from the module to the owner-controller and the features that are available to your application. You choose a data format when you choose a Communications Format. For more information on Communications Format, see page 10-6.

You can choose one of the two following data formats:

- Integer mode
- Floating point mode

Table 5.2 shows which features are available in each format.

**Table 5.2 Features Available in Each Data Format**

| Data format: | Features available: | Features not available: |
|---|---|---|
| Integer mode | Multiple input ranges<br>Notch filter<br>Real time sampling | Digital filtering<br>Process alarms<br>Rate alarms<br>Scaling |
| Floating point mode | All features | N/A |

## Features Specific to the 1756-IF6I and 1756-IF6CIS Modules

Table 5.3 lists features that are specific to the 1756-IF6CIS and 1756-IF6I modules. The features are described later in this section.

**Table 5.3**

| Feature: | Page of description: |
|---|---|
| Multiple Input Ranges[1] | 5-5 |
| Notch Filter | 5-6 |
| Real Time Sampling | 5-7 |
| Underrange/Overrange Detection | 5-7 |
| Digital Filter | 5-8 |
| Process Alarms | 5-9 |
| Rate Alarm | 5-10 |
| Wire Off Detection | 5-11 |

(1) Only the 1756-IF6I offers multiple input ranges. The 1756-IF6CIS module only operates in the 0 to 20mA range.

## Multiple Input Ranges

You can only use the 1756-IF6CIS module in current applications. Unlike other analog input modules, this module does not allow you to choose an input range. All channels use the 0 to 20mA input range.

For the 1756-IF6I module, however, you can select from a series of operational ranges for **each channel** on your module. The range designates the minimum and maximum signals that are detectable by the module. The 1756-IF6I module offers multiple input ranges in both current and voltage applications.

Table 5.4 lists the possible input ranges available for use with the 1756-IF6CIS and 1756-IF6I modules.

**Table 5.4 Possible Input Ranges**

| Module: | Available input ranges: |
|---|---|
| 1756-IF6CIS | 0 to 20mA |
| 1756-IF6I | -10 to 10V<br>0 to 5V<br>0 to 10V<br>0 to 20mA |

For an example of how to choose an input range for your module, see page 10-10.

## Notch Filter

An Analog-to-Digital Convertor (ADC) filter removes line noise in your application for **each channel**.

Choose a notch filter that most closely matches the anticipated noise frequency in your application. Remember that each filter time affects the response time of your module. Also, the highest frequency notch filter settings also limit the effective resolution of the channel.

**IMPORTANT** 60Hz is the default setting for the notch filter.

Table 5.5 lists the available notch filter setting.

**Table 5.5 Module Filter Settings**

| Notch setting: | 10Hz | 50Hz | 60Hz (Default) | 100Hz | 250Hz | 1000Hz |
|---|---|---|---|---|---|---|
| Minimum Sample Time (RTS) – Integer mode(1) | 102mS | 22mS | 19mS | 12mS | 10mS | 10mS |
| Minimum Sample Time (RTS) – Floating point mode(2) | 102mS | 25mS | 25mS | 25mS | 25mS | 25mS |
| 0-100% Step Response Time(2) | 400mS + RTS | 80mS + RTS | 68mS + RTS | 40mS + RTS | 16mS + RTS | 4mS + RTS |
| -3dB Frequency | 3Hz | 13Hz | 16Hz | 26Hz | 66Hz | 262Hz |
| Effective Resolution | 16 bits | 16 bits | 16 bits | 16 bits | 15 bits | 10 bits |

(1) Integer mode must be used for RTS values lower than 25mS. The minimum RTS value for the module will be dependent on the channel with the lowest notch filter setting.

(2) Worst case settling time to 100% of a step change would include 0-100% step response time plus one RTS sample time.

To see how to choose a Notch Filter, see page 10-11.

## Real Time Sampling

This parameter instructs the module to scan its input channels and obtain all available data. After the channels are scanned, the module multicasts that data.

During module configuration, you specify a Real Time Sampling (RTS) period and a Requested Packet Interval (RPI) period. These features both instruct the module to multicast data, but only the RTS feature instructs the module to scan its channels before multicasting.

For more information on Real Time Sampling, see page 2-4. For an example of how to set the RTS rate, see page 10-10.

## Underrange/Overrange Detection

This feature detects when the isolated input module is operating beyond limits set by the input range. For example, If you are using the 1756-IF6I module in the 0V-10V input range and the module voltage increases to 11V, the Overrange detection detects this condition.

Table 5.6 lists the input ranges of the 1756-IF6CIS and 1756-IF6I modules and the lowest/highest signal available in each range before the module detects an underrange/overrange condition:

**Table 5.6 Low and High Signal Limits on the Isolated Input Module**

| Input module: | Available range: | Lowest signal in range: | Highest signal in range: |
|---|---|---|---|
| 1756-IF6CIS | 0mA-20mA | 0mA | 21.09376mA |
| 1756-IF6I | +/- 10V | -10.54688V | 10.54688V |
| | 0V-10V | 0V | 10.54688V |
| | 0V-5V | 0V | 5.27344V |
| | 0mA-20mA | 0mA | 21.09376mA |

## Digital Filter

**IMPORTANT** The digital filter is only available in applications using floating point mode.

The digital filter smooths input data noise transients on **each input channel**. This value specifies the time constant for a digital first order lag filter on the input. It is specified in units of milliseconds. A value of 0 disables the filter.

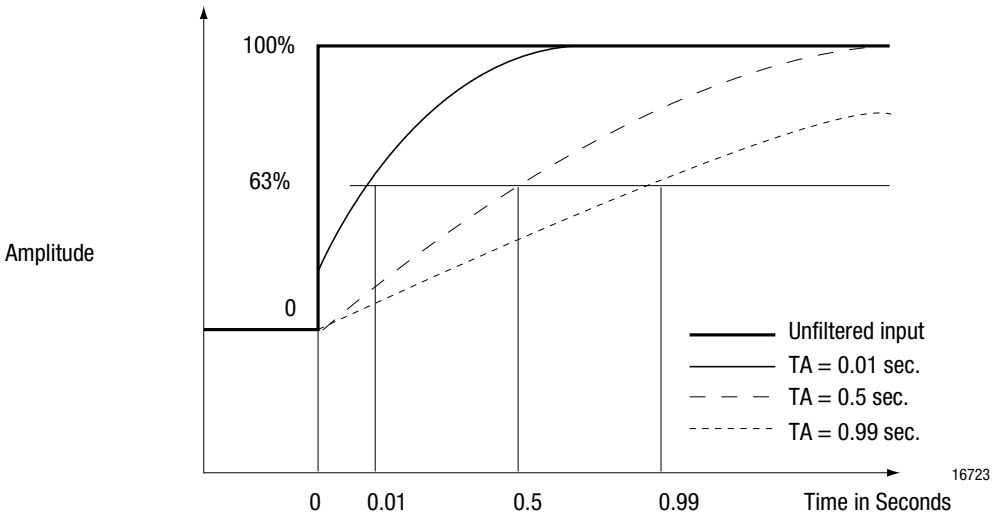
The digital filter equation is a classic first order lag equation.

$$Yn = Yn\text{-}1 + \frac{[\Delta t]}{\Delta t + TA} (X_n - Y_n\text{-}1)$$

Yn = present output, filtered peak voltage (PV)
Yn-1 = previous output, filtered PV
Δt = module channel update time (seconds)
TA = digital filter time constant (seconds)
Xn = present input, unfiltered PV

Using a step input change to illustrate the filter response, you can see that when the digital filter time constant elapses, 63.2% of the total response is reached. Each additional time constant achieves 63.2% of the remaining response. For more information, see Figure 5.1.

**Figure 5.1**




To see how to set the Digital Filter, see page 10-10.

## Process Alarms

Process alarms alert you when the module has exceeded configured high or low limits for **each channel**. You can latch process alarms. These are set at four user configurable alarm trigger points:

- High high
- High
- Low
- Low low

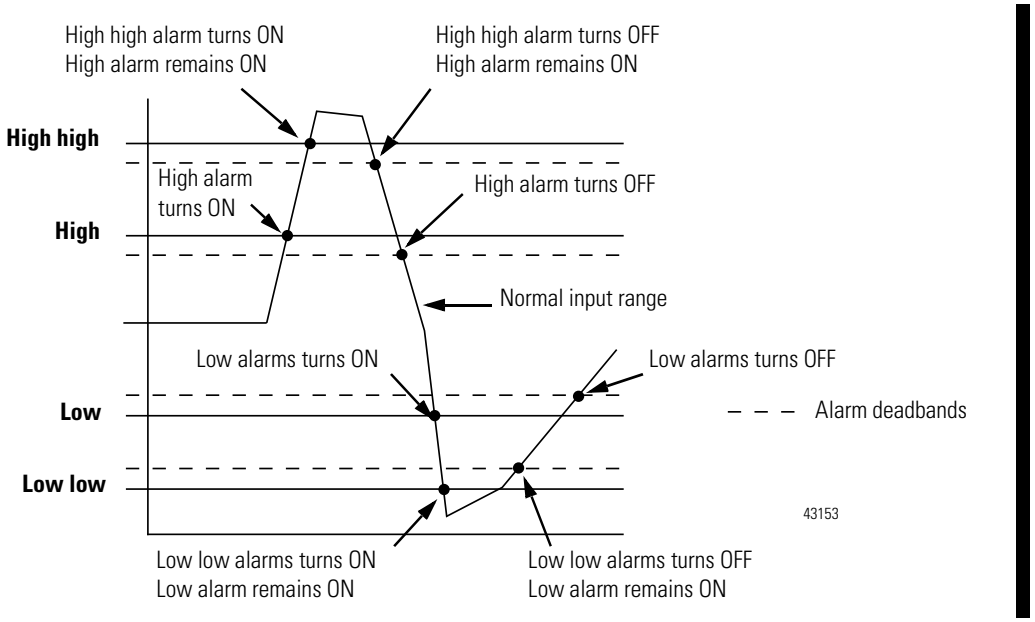
**IMPORTANT** Process alarms are only available in applications using floating point mode. The values for each limit are entered in scaled engineering units.

### *Alarm Deadband*

You may configure an **Alarm Deadband** to work with these alarms. The deadband allows the process alarm status bit to remain set, despite the alarm condition disappearing, as long as the input data remains within the deadband of the process alarm.

Figure 5.2 shows input data that sets each of the four alarms at some point during module operation. In this example, Latching is disabled; therefore, each alarms turns OFF when the condition that caused it to set ceases to exist.

**Figure 5.2**




To see how to set Process Alarms, see page 10-10.

## Rate Alarm

The rate alarm triggers if the rate of change between input samples for **each channel** exceeds the specified trigger point for that channel.

**IMPORTANT** The rate alarm is only available in applications using floating point mode.

**EXAMPLE**

**1756-IF6CIS**

For example, if you set an 1756-IF6I (with normal scaling in mA) to a rate alarm of 1.0 mA/S, the rate alarm only triggers if the difference between measured input samples changes at a rate > 1.0 mA/S.

If the module's RTS is 100 ms (i.e. sampling new input data every 100ms) and at time 0, the module measures 5.0mA and at time 100ms measures 5.08mA, the rate of change is (5.08mA - 5.0mA) / (100mS) = 0.8mA/S. The rate alarm would not set as the change is less than the trigger point of 1.0mA/s.

If the next sample taken is 4.9mA, the rate of change is (4.9mA-5.08V)/(100mS)=-1.8mA/S. The absolute value of this result is > 1.0mA/S, so the rate alarm will set. Absolute value is used because rate alarm checks for the magnitude of the rate of change being beyond the trigger point, whether a positive or negative excursion.

**1756-IF6I**

For example, if you set an 1756-IF6I (with normal scaling in Volts) to a rate alarm of 1.0 V/S, the rate alarm only triggers if the difference between measured input samples changes at a rate > 1.0 V/S.

If the module's RTS is 100 ms (i.e. sampling new input data every 100ms) and at time 0, the module measures 5.0 volts and at time 100ms measures 5.08 V, the rate of change is (5.08V - 5.0V) / (100mS) = 0.8 V/S. The rate alarm would not set as the change is less than the trigger point of 1.0V/s.

If the next sample taken is 4.9V, the rate of change is (4.9V-5.08V)/(100mS)=-1.8V/S. The absolute value of this result is > 1.0V/S, so the rate alarm will set. Absolute value is used because rate alarm checks for the magnitude of the rate of change being beyond the trigger point, whether a positive or negative excursion.

To see how to set the Rate Alarm, see page 10-10.

## Wire Off Detection

The 1756-IF6CIS and 1756-IF6I modules will alert you when a wire has been disconnected from one of its channels or the RTB has been removed from the module. When a wire off condition occurs for this module, two events occur:

- Input data for that channel changes to a specific scaled value
- A fault bit is set in the owner-controller which may indicate the presence of a wire off condition

Because the 1756-IF6I module can be used in voltage or current applications, differences exist as to how a wire off condition is detected in each application. The 1756-IF6CIS module can only be used in current mode. Table 5.7 lists the differences that occur when a wire off condition occurs in various applications.

**Table 5.7**

| When the Wire Off condition occurs in this application: | The following events occur: |
|---|---|
| Voltage Applications<br><br>1756-IF6I only | • Input data for that channel changes to the scaled value associated with the **overrange** signal value of the selected operational range in floating point mode (maximum possible scaled value) or 32,767 counts in integer mode<br><br>• The ChxOverrange (x=channel number) tag is set to 1 |
| Current Applications | • Input data for that channel changes to the scaled value associated with the **underrange** signal value of the selected operational range in floating point mode (minimum possible scaled value) or -32,768 counts in integer mode<br><br>• The ChxUnderrange (x=channel number) tag is set to 1<br><br>In current applications, if wire off detection occurs because the RTB has been disconnected from the module, the module reacts with the same conditions as described in voltage applications. |

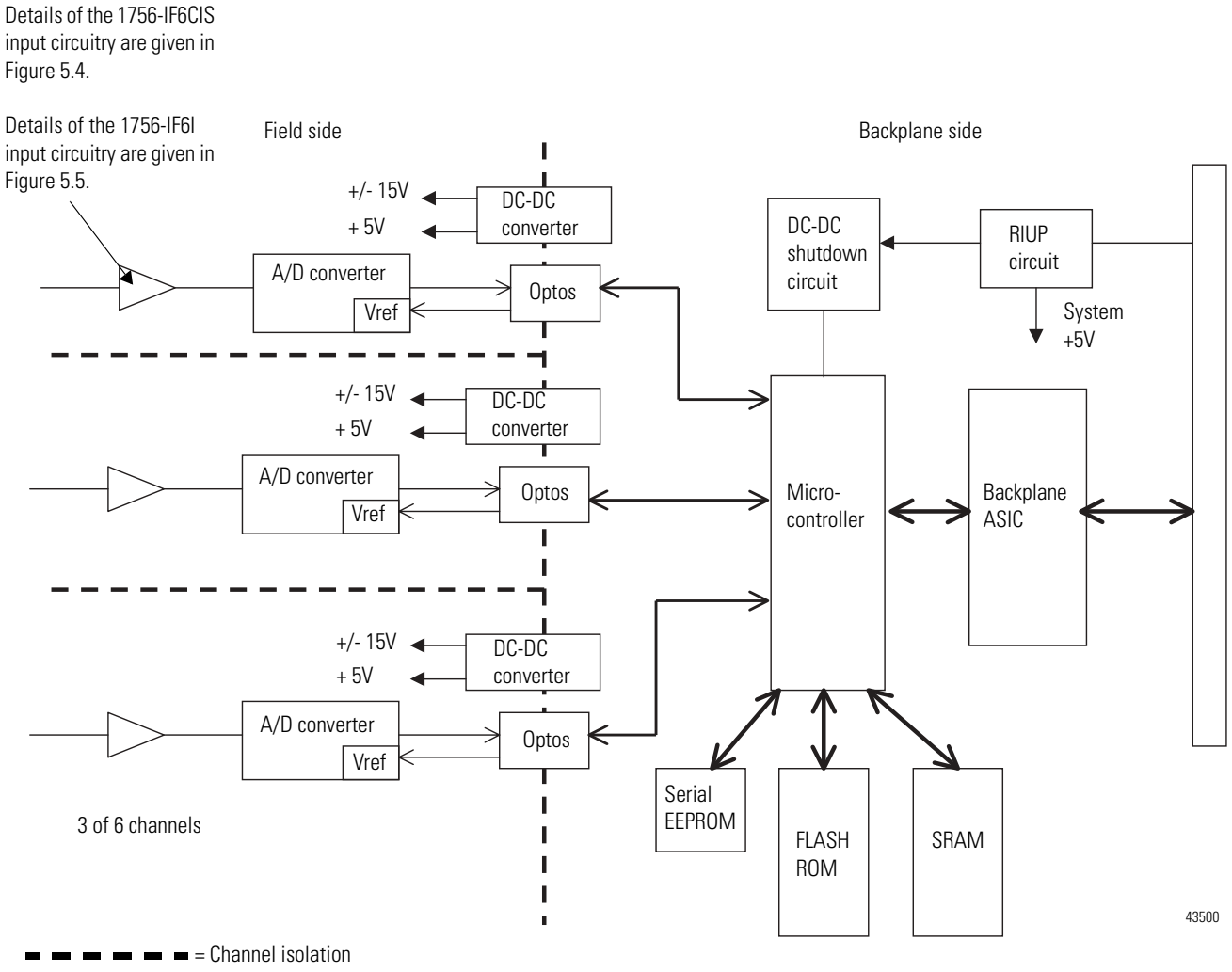
For more information about tags in the tag editor, see Appendix B.

# Using Module Block and Input Circuit Diagrams

This section shows the 1756-IF6CIS and 1756-IF6I modules' block diagrams and input circuit diagrams.

## Module Block Diagrams

**Figure 5.3 1756-IF6CIS and 1756-IF6I Module Block Diagram**



# Field Side Circuit Diagrams

**Figure 5.4 1756-IF6CIS Input Circuit**

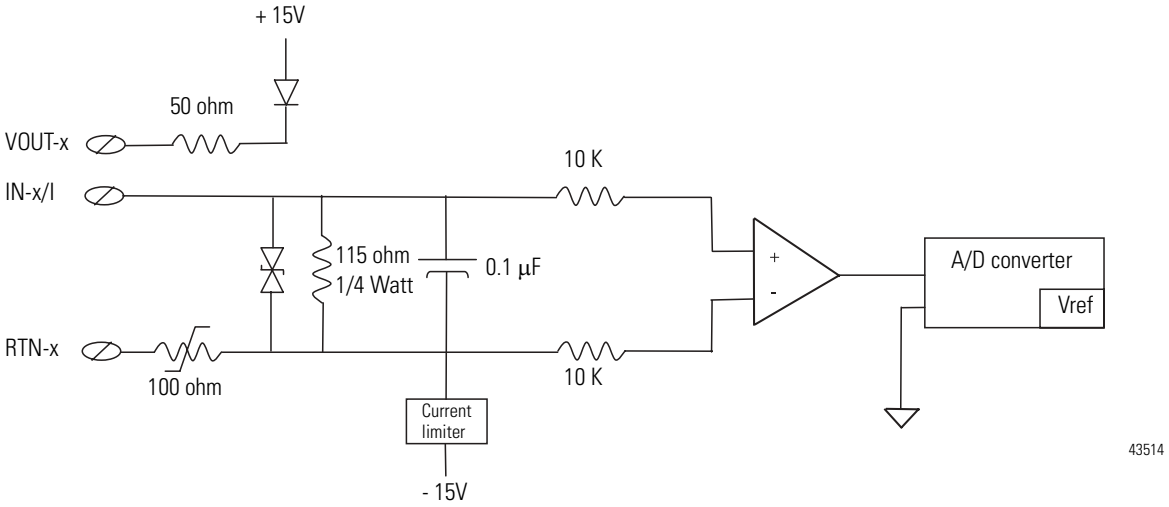
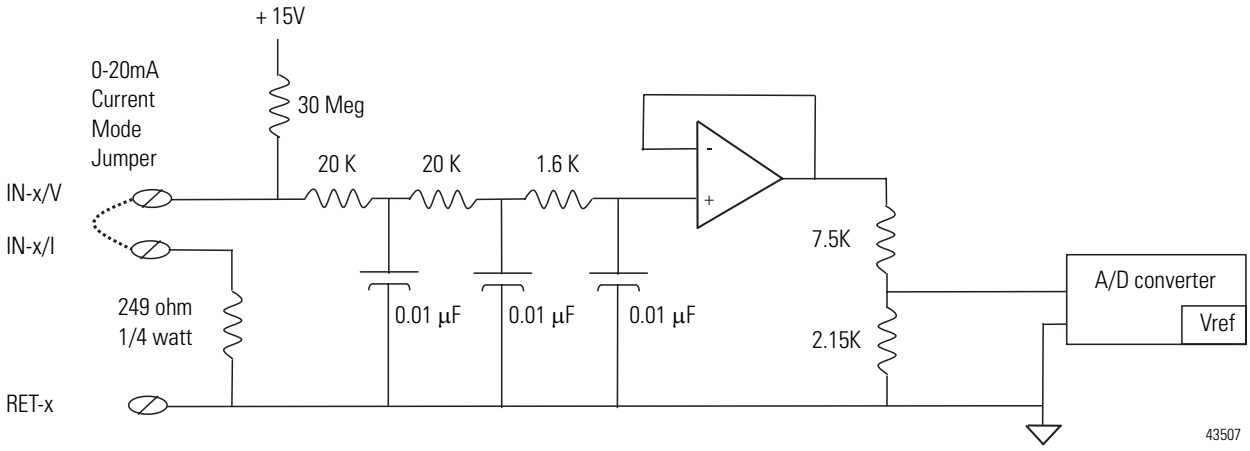
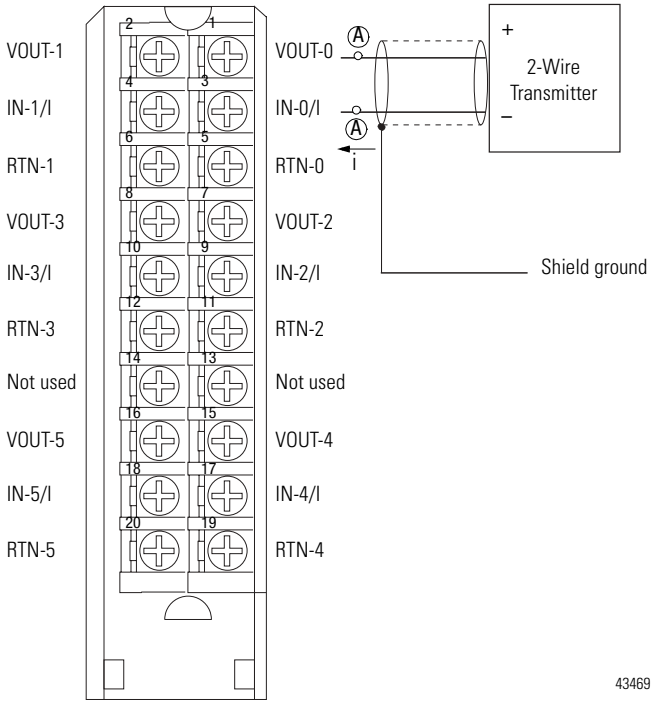



**Figure 5.5 1756-IF6I Input Circuit**



# Wiring the 1756-IF6CIS Module

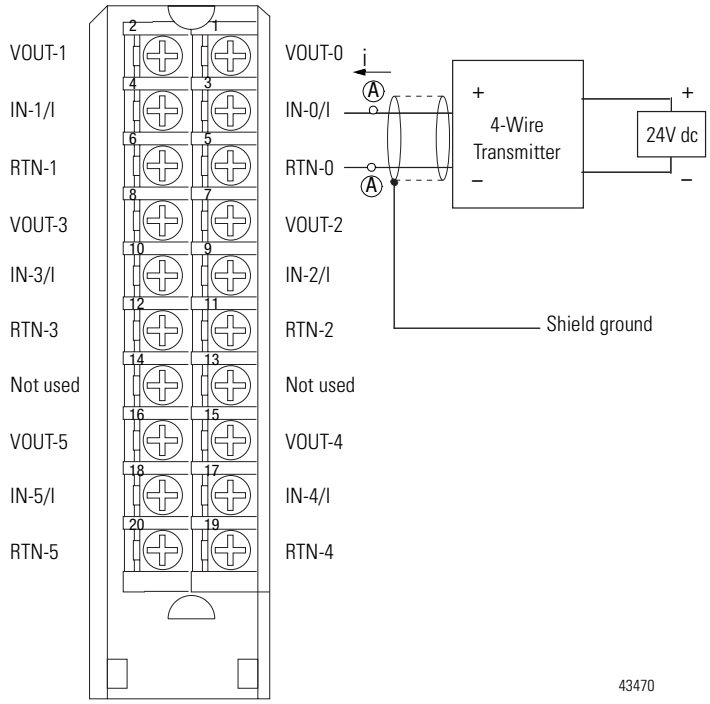
**Figure 5.6 1756-IF6CIS – 2-wire transmitter connected to the module and the module providing 24V dc loop power**




**NOTE**:

1. Do not connect more than 2 wires to any single terminal.
2. Place additional loop devices (e.g. strip chart recorders) at either A location in the current loop.

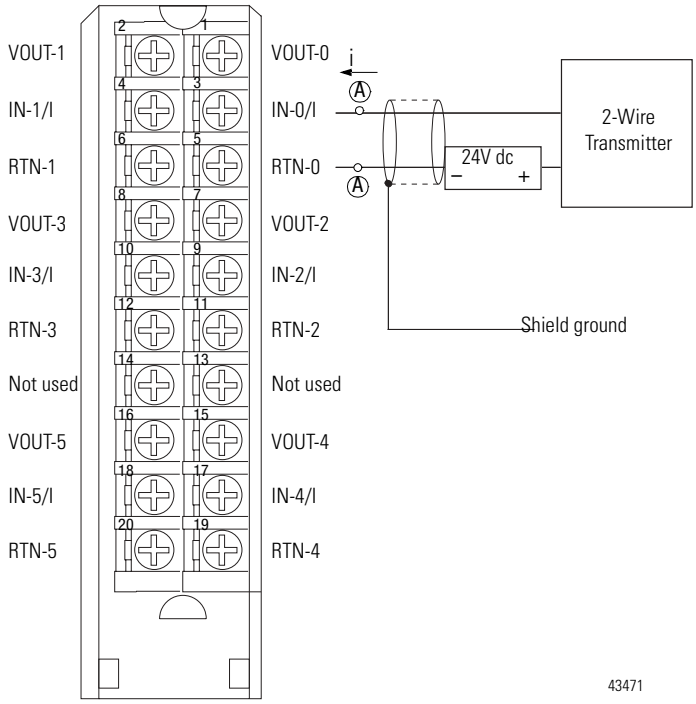
**Figure 5.7 1756-IF6CIS – 4-wire transmitter connected to the module and an external, user-provided power supply providing 24V dc loop power**




**NOTES**:

1. If separate power sources are used, do not exceed the specified isolation voltage.
2. Do not connect more than 2 wires to any single terminal.
3. Place additional loop devices (e.g. strip chart recorders) at either A location in the current loop.

**Figure 5.8 1756-IF6CIS – 2-wire transmitter connected to the module and an external, user-provided power supply providing 24V dc loop power**

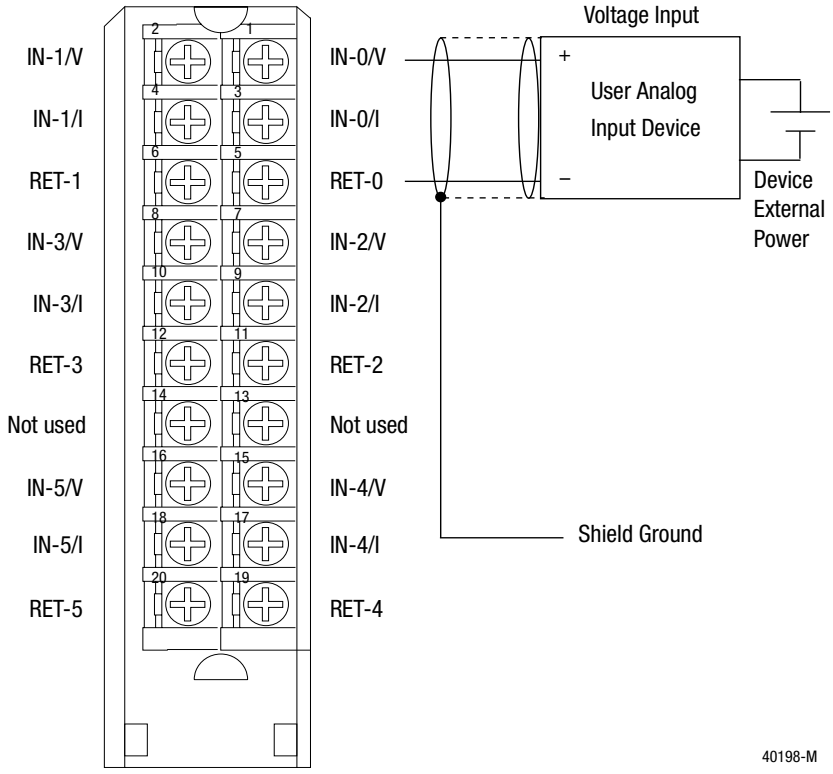



**NOTES**:

1. If separate power sources are used, do not exceed the specified isolation voltage.
2. Do not connect more than 2 wires to any single terminal.
3. Place additional loop devices (e.g. strip chart recorders) at either A location in the current loop.

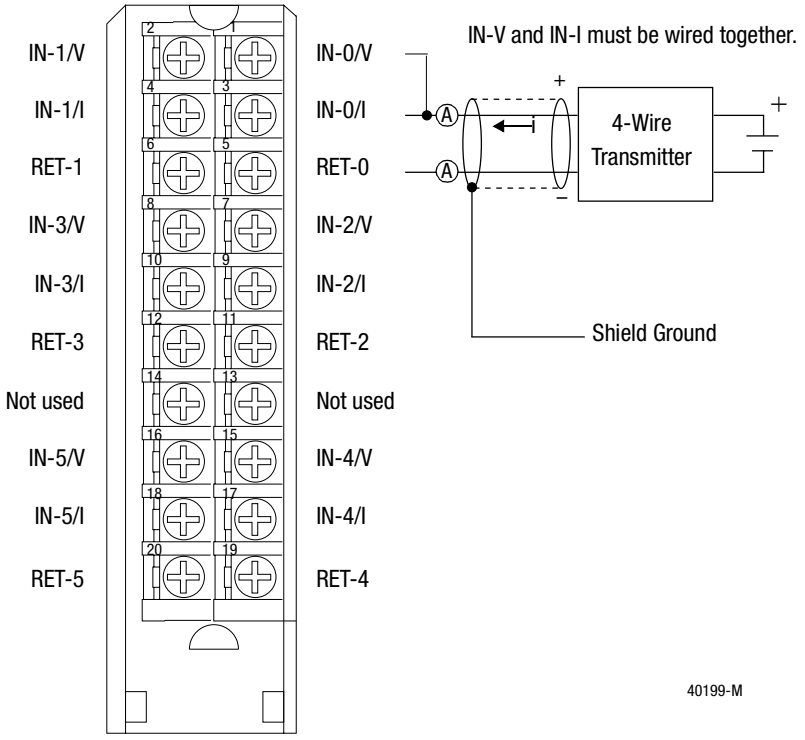
# Wiring the 1756-IF6I Module

**Figure 5.9 1756-IF6I Voltage wiring example**




**NOTES**: Do not connect more than 2 wires to any single terminal.

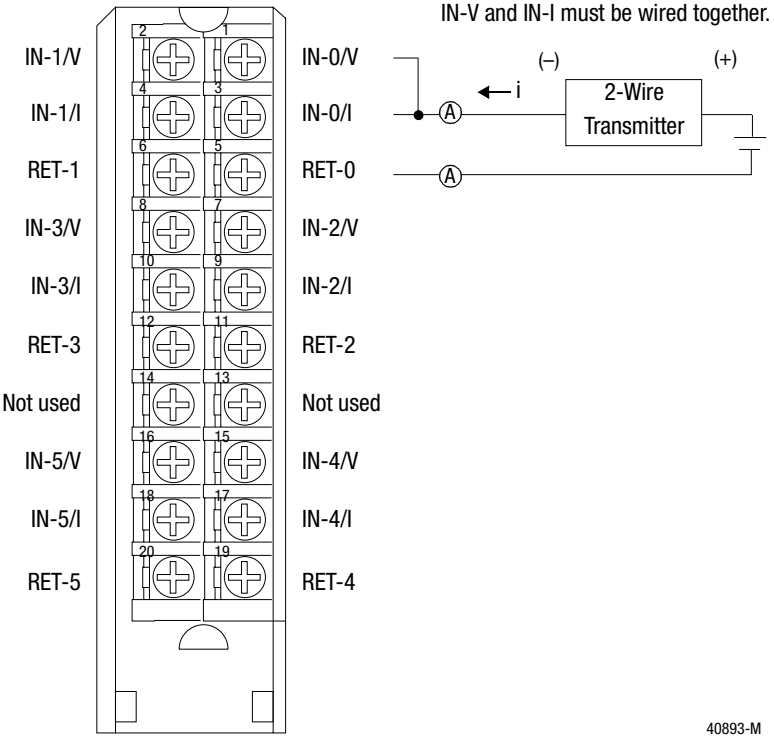
**Figure 5.10 1756-IF6I Current wiring example with a 4-wire transmitter**




NOTE: Place additional loop devices (e.g. strip chart recorders, etc.) at either A location.

**NOTES**: Do not connect more than 2 wires to any single terminal.

**Figure 5.11 1756-IF6I Current wiring example with a 2-wire transmitter**




NOTE: Place additional loop devices (e.g. strip chart recorders, etc.) at either A location.

**NOTES**: Do not connect more than 2 wires to any single terminal.

## 1756-IF6CIS or 1756-IF6I Module Fault and Status Reporting

The 1756-IF6CIS and 1756-IF6I modules multicast status/fault data to the owner/listening controllers with its channel data. The fault data is arranged in such a manner as to allow the user to choose the level of granularity he desires for examining fault conditions.

Three levels of tags work together to provide increasing degree of detail as to the specific cause of faults on the module.

Table 5.8 lists tags that can be examined in ladder logic to indicate when a fault has occurred:

**Table 5.8**

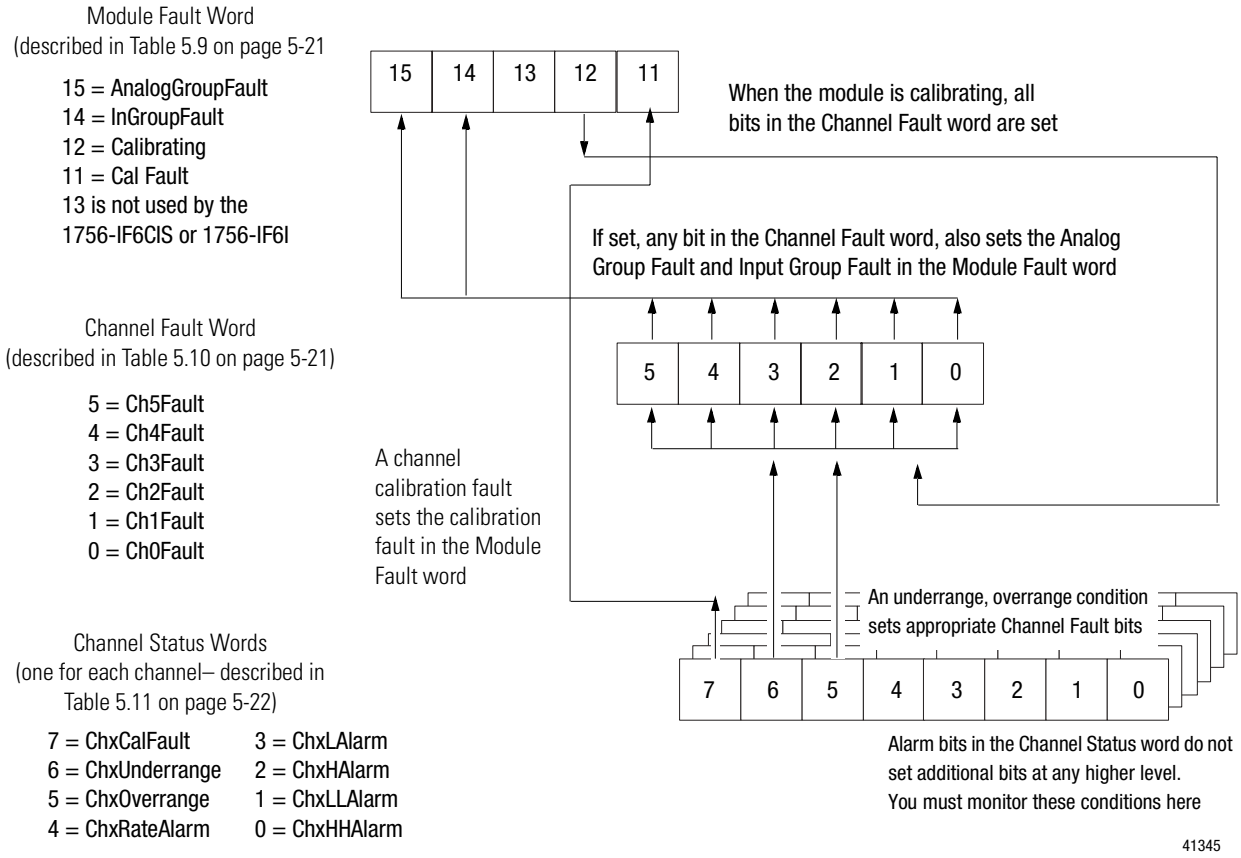
| Tag: | Description: |
|---|---|
| Module Fault Word | This word provides fault summary reporting. Its tag name is ModuleFaults. |
| Channel Fault Word | This word provides underrange, overrange and communications fault reporting. Its tag name is ChannelFaults. |
| Channel Status Words | This word provides individual channel underrange and overrange fault reporting for process alarms, rate alarms and calibration faults. Its tag name is ChxStatus. |

**IMPORTANT** Differences exist between floating point and integer modes as they relate to module fault reporting. These differences are explained in the following two sections.

# Fault Reporting in Floating Point Mode

Figure 5.12 provides an overview of the fault reporting process in floating point mode.

**Figure 5.12**


Module Fault Word
(described in Table 5.9 on page 5-21
15 = AnalogGroupFault
14 = InGroupFault
12 = Calibrating
11 = Cal Fault
13 is not used by the
1756-IF6CIS or 1756-IF6I
15 14 13 12 11
When the module is calibrating, all
bits in the Channel Fault word are set
If set, any bit in the Channel Fault word, also sets the Analog
Group Fault and Input Group Fault in the Module Fault word
Channel Fault Word
(described in Table 5.10 on page 5-21)
5 = Ch5Fault
4 = Ch4Fault
3 = Ch3Fault
2 = Ch2Fault
1 = Ch1Fault
0 = Ch0Fault
5 4 3 2 1 0
A channel
calibration fault
sets the calibration
fault in the Module
Fault word
An underrange, overrange condition
sets appropriate Channel Fault bits
Channel Status Words
(one for each channel– described in
Table 5.11 on page 5-22)
7 = ChxCalFault
6 = ChxUnderrange
5 = ChxOverrange
4 = ChxRateAlarm
3 = ChxLAlarm
2 = ChxHAlarm
1 = ChxLLAlarm
0 = ChxHHAlarm
7 6 5 4 3 2 1 0
Alarm bits in the Channel Status word do not
set additional bits at any higher level.
You must monitor these conditions here
41345

## Module Fault Word Bits – Floating Point Mode

Bits in this word provide the highest level of fault detection. A nonzero condition in this word reveals that a fault exists on the module. You can examine further down to isolate the fault.

Table 5.9 lists tags that can be examined in ladder logic to indicate when a fault has occurred:

**Table 5.9**

| Tag: | Description: |
|---|---|
| Analog Group Fault | This bit is set when any bits in the Channel Fault word are set. Its tag name is AnalogGroupFault. |
| Input Group Fault | This bit is set when any bits in the Channel Fault word are set. Its tag name is InputGroup. |
| Calibrating | This bit is set when any channel is being calibrated. When this bit is set, all bits in the Channel Fault word are set. Its tag name is Calibrating. |
| Calibration Fault | This bit is set when any of the individual Channel Calibration Fault bits are set. Its tag name is CalibrationFault. |

## Channel Fault Word Bits – Floating Point Mode

During normal module operation, bits in the Channel Fault word are set if any of the respective channels has an Under or Overrange condition. Checking this word for a nonzero value is a quick way to check for Under or Overrange conditions on the module.

Table 5.10 lists the conditions that set **all** Channel Fault word bits:

**Table 5.10**

| This condition sets all Channel Fault word bits: | And causes the module to display the following in the Channel Fault word bits: |
|---|---|
| A channel is being calibrated | "003F" for all bits |
| A communications fault occurred between the module and its owner-controller | "FFFF" for all bits |

Your logic can monitor the Channel Fault Word bit for a particular input to determine the state of that point.

## Channel Status Word Bits – Floating Point Mode

Any of the 6 Channel Status words, one for each channel, will display a nonzero condition if that particular channel has faulted for the conditions listed below. Some of these bits set bits in other Fault words. When the Underrange and Overrange bits (bits 6 & 5) in any of the words are set, the appropriate bit is set in the Channel Fault word.

When the Calibration Fault bit (bit 7) is set in any of the words, the Calibration Fault bit (bit 11) is set in the Module Fault word. Table 5.11 lists the conditions that set each of the word bits.

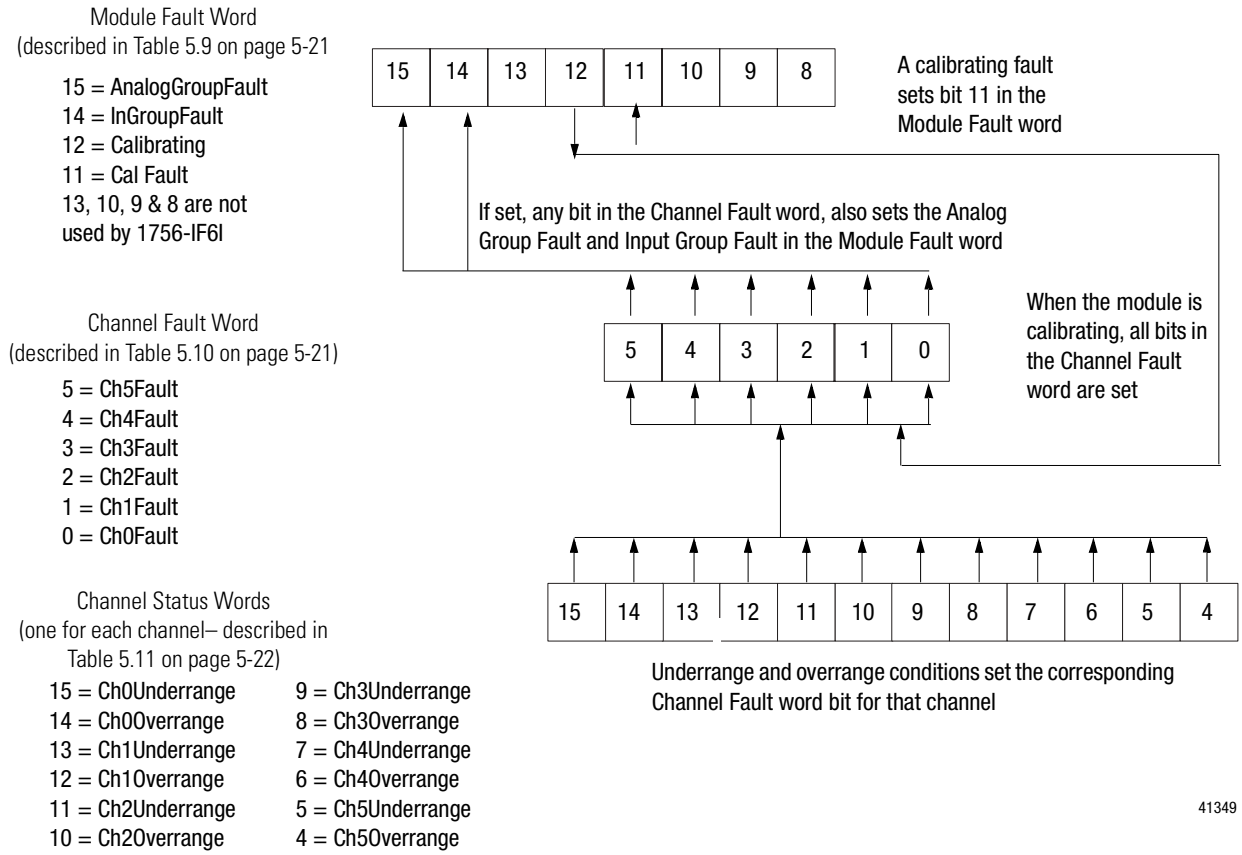
**Table 5.11**

| Tag (Status word): | Bit: | Event that sets this tag: |
|---|---|---|
| ChxCalFault | Bit 7 | This bit is set if an error occurs during calibration for that channel, causing a bad calibration. This bit also sets bit 9 in the Module Fault word. |
| Underrange | Bit 6 | This bit is set when the input signal at the channel is less than or equal to the minimum detectable signal. For more information on the minimum detectable signal for each module, see Table 5.6 on page 5-7. This bit also sets the appropriate bit in the Channel Fault word. |
| Overrange | Bit 5 | This bit is set when the input signal at the channel is greater than or equal to the maximum detectable signal. For more information on the maximum detectable signal for each module, see Table 5.6 on page 5-7. This bit also sets the appropriate bit in the Channel Fault word. |
| ChxRateAlarm | Bit 4 | This bit is set when the input channel's rate of change exceeds the configured Rate Alarm parameter. It remains set until the rate of change drops below the configured rate. If latched, the alarm remains set until it is unlatched. |
| ChxLAlarm | Blt 3 | This bit is set when the input signal moves beneath the configured Low Alarm limit. It remains set until the signal moves above the configured trigger point. If latched, the alarm will remain set until it is unlatched. If a deadband is specified, the alarm will also remain set as long as the signal remains within the configured deadband. |
| ChxHAlarm | Bit 2 | This bit is set when the input signal moves above the configured High Alarm limit. It remains set until the signal moves below the configured trigger point. If latched, the alarm remains set until it is unlatched. If a deadband is specified, the alarm also remains set as long as the signal remains within the configured deadband. |
| ChxLLAlarm | Bit 1 | This bit is set when the input signal moves beneath the configured Low-Low Alarm limit. It remains set until the signal moves above the configured trigger point. If latched, the alarm remains set until it is unlatched. If a deadband is specified, the alarm also remains latched as long as the signal remains within the configured deadband. |
| ChxHHAlarm | Bit 0 | This bit is set when the input signal moves above the configured High-High Alarm limit. It remains set until the signal moves below the configured trigger point. If latched, the alarm remains set until it is unlatched. If a deadband is specified, the alarm also remains latched as long as the signal remains within the configured deadband. |

## Fault Reporting in Integer Mode

Figure 5.13 offers an overview of the fault reporting process in integer mode.

**Figure 5.13**


Module Fault Word
(described in Table 5.9 on page 5-21
15 = AnalogGroupFault
14 = InGroupFault
12 = Calibrating
11 = Cal Fault
13, 10, 9 & 8 are not used by 1756-IF6I
15 14 13 12 11 10 9 8
A calibrating fault sets bit 11 in the Module Fault word
If set, any bit in the Channel Fault word, also sets the Analog Group Fault and Input Group Fault in the Module Fault word
Channel Fault Word
(described in Table 5.10 on page 5-21)
5 = Ch5Fault
4 = Ch4Fault
3 = Ch3Fault
2 = Ch2Fault
1 = Ch1Fault
0 = Ch0Fault
5 4 3 2 1 0
When the module is calibrating, all bits in the Channel Fault word are set
Channel Status Words
(one for each channel– described in Table 5.11 on page 5-22)
15 = Ch0Underrange
14 = Ch0Overrange
13 = Ch1Underrange
12 = Ch1Overrange
11 = Ch2Underrange
10 = Ch2Overrange
9 = Ch3Underrange
8 = Ch3Overrange
7 = Ch4Underrange
6 = Ch4Overrange
5 = Ch5Underrange
4 = Ch5Overrange
15 14 13 12 11 10 9 8 7 6 5 4
Underrange and overrange conditions set the corresponding Channel Fault word bit for that channel
41349

## Module Fault Word Bits – Integer Mode

In integer mode, Module Fault word bits (bits 15-8) operate exactly as described in floating point mode. Table 5.12 lists tags that can be examined in ladder logic to indicate when a fault has occurred:

**Table 5.12**

| Tag: | Description: |
|---|---|
| Analog Group Fault | This bit is set when any bits in the Channel Fault word are set. Its tag name is AnalogGroupFault. |
| Input Group Fault | This bit is set when any bits in the Channel Fault word are set. Its tag name is InputGroup. |
| Calibrating | This bit is set when any channel is being calibrated. When this bit is set, all bits in the Channel Fault word are set. Its tag name is Calibrating. |
| Calibration Fault | This bit is set when any of the individual Channel Calibration Fault bits are set. Its tag name is CalibrationFault. |

## Channel Fault Word Bits – Integer Mode

In integer mode, Channel Fault word bits operate exactly as described in floating point mode. Table 5.13 lists the conditions that set **all** Channel Fault word bits:

**Table 5.13**

| This condition sets all Channel Fault word bits: | And causes the module to display the following in the Channel Fault word bits: |
|---|---|
| A channel is being calibrated | "003F" for all bits |
| A communications fault occurred between the module and its owner-controller | "FFFF" for all bits |

Your logic can monitor the Channel Fault Word bit for a particular input to determine the state of that point.

## Channel Status Word Bits – Integer Mode

The Channel Status word has the following differences when used in integer mode:

- Only Underrange and Overrange conditions are reported by the module.
- Alarming and Calibration Fault activities are not available, although the Calibration Fault bit in the Module Fault word will activate if a channel is not properly calibrated.
- There is only 1 Channel Status word for all 6 channels.

When the Calibration Fault bit (bit 7) is set in any of the words, the Calibration Fault bit (bit 9) is set in the Module Fault word. Table 5.14 lists the conditions that set each of the words.

**Table 5.14**

| Tag (Status word): | Bit: | Event that sets this tag: |
|---|---|---|
| ChxUnderrange | Odd-numbered bits from bit 15 to bit 5 (e.g. bit 15 represents channel 0).<br><br>For a full listing of the channels these bits represent, see Figure 5.13 on page 5-23. | The underrange bit is set when the input signal at the channel is less than or equal to the minimum detectable signal.<br><br>For more information on the minimum detectable signal for each module, see Table 5.6 on page 5-7. This bit also sets the appropriate bit in the Channel Fault word. |
| ChxOverrange | Even-numbered bits from bit 14 to bit 4 (e.g. bit 14 represents channel 0).<br><br>For a full listing of the channels these bits represent, see Figure 5.13 on page 5-23. | The overrange bit is set when the input signal at the channel is greater than or equal to the maximum detectable signal.<br><br>For more information on the maximum detectable signal for each module, see Table 5.6 on page 5-7. This bit also sets the appropriate bit in the Channel Fault word. |

## Chapter Summary and What's Next

In this chapter you learned about features specific to the Sourcing Current Loop Input Module (1756-IF6CIS) and Isolated Analog Voltage/Current Input Module (1756-IF6I).

Chapter 6 describes features specific to the Temperature Measuring Analog Modules (1756-IR6I, 1756-IT6I & 1756-IT6I2).

# Temperature Measuring Analog Modules (1756-IR6I, 1756-IT6I & 1756-IT6I2)

## What This Chapter Contains

This chapter describes features specific to temperature measuring ControlLogix analog modules.


| For information about: | See page: |
|---|---|
| Choosing a Data Format | 6-2 |
| Features Specific to Temperature Measuring Modules | 6-3 |
| Differences Between the 1756-IT6I and 1756-IT6I2 Modules | 6-12 |
| Using Module Block and Input Circuit Diagrams | 6-17 |
| Wiring the 1756-IR6I Module | 6-19 |
| Wiring the 1756-IT6I Module | 6-20 |
| Wiring the 1756-IT6I2 Module | 6-21 |
| 1756-IR6I, 1756-IT6I and 1756-IT6I2 Fault and Status Reporting | 6-22 |


The temperature-measuring modules also support features described in Chapter 3. Table 6.1 lists those additional features.

**Table 6.1 Additional Features Supported by the Temperature Measuring Modules**

| Feature: | Page of description: |
|---|---|
| Removal and Insertion Under Power (RIUP) | 3-2 |
| Module Fault Reporting | 3-3 |
| Fully Software Configurable | 3-3 |
| Electronic Keying | 3-4 |
| Access to System Clock for Timestamping Functions | 3-6 |
| Rolling Timestamp | 3-6 |
| Producer/Consumer Model | 3-6 |
| Status Indicator Information | 3-7 |
| Full Class I Division 2 Compliance | 3-7 |
| UL, CSA, FM, CE, C-Tick, EEx, TUV Agency Certification | 3-7 |
| Field Calibration | 3-8 |
| Sensor Offset | 3-8 |
| Latching of Alarms | 3-8 |

## Choosing a Data Format

Data format determines the features that are available to your application. You choose a data format when you choose a Communications Format. For more information on Communications Format, see page 10-6.

You can choose one of the two following data formats:

- Integer mode
- Floating point mode

Table 6.2 shows what features are available in each format.

**Table 6.2 Features Available in Each Data Format**

| Data format: | Features available: | Features not available: |
|---|---|---|
| Integer mode | Multiple input ranges<br>Notch filter<br>Real time sampling<br>Cold Junction Temperature – (1756-IT6I and 1756-IT6I2 only) | Temperature linearization<br>Process alarms<br>Digital filtering<br>Rate alarms |
| Floating point mode | All features | N/A |

**IMPORTANT** Integer mode does not support temperature conversion on temperature measuring modules. If you choose integer mode, the 1756-IR6I is strictly an ohms (Ω) module and the 1756-IT6I and 1756-IT6I2 are strictly millivolts (mV) modules.

## Features Specific to Temperature Measuring Modules

Table 6.3 lists features that are specific to the temperature-measuring modules. The features are described later in this section.

**Table 6.3**

| Feature: | Page of description: |
|---|---|
| Multiple Input Ranges | 6-3 |
| Notch Filter | 6-4 |
| Real Time Sampling | 6-5 |
| Underrange/Overrange Detection | 6-5 |
| Digital Filter | 6-6 |
| Process Alarms | 6-7 |
| Rate Alarm | 6-8 |
| 10 Ohm Offset | 6-8 |
| Wire Off Detection | 6-9 |
| Sensor Type | 6-10 |
| Temperature Units | 6-12 |
| Cold Junction Compensation | 6-13 |

## Multiple Input Ranges

You can select from a series of operational ranges for **each channel** on your module. The range designates the minimum and maximum signals that are detectable by the module.

**Table 6.4 Possible Input Ranges**

| Module: | Possible ranges: |
|---|---|
| 1756-IR6I | 1 to 487Ω<br>2 to 1000Ω<br>4 to 2000Ω<br>8 to 4080Ω |
| 1756-IT6I and 1756-IT6I2 | -12 to +78mV<br>-12 to +30mV |

For an example of how to choose an input range for your module, see page 10-10.

## Notch Filter

An Analog-to-Digital Convertor (ADC) filter removes line noise in your application for **each channel**.

Choose a notch filter that most closely matches the anticipated noise frequency in your application. Remember that each filter time affects the response time of your module. Also, the highest frequency notch filter settings also limit the effective resolution of the channel.

**IMPORTANT** 60Hz is the default setting for the notch filter.

Table 6.5 lists the available notch filter setting.

**Table 6.5 Notch Filter Settings**

| Notch setting: | 10Hz | 50Hz | 60Hz (Default) | 100Hz | 250Hz | 1000Hz |
|---|---|---|---|---|---|---|
| Minimum Sample Time (RTS – Integer mode)(1) | 102mS | 22mS | 19mS | 12mS | 10mS | 10mS |
| Minimum Sample Time (RTS – Floating point mode)(2) | 102mS | 25mS | 25mS | 25mS | 25mS | 25mS |
| 0-100% Step Response Time(3) | 400mS + RTS | 80mS + RTS | 68mS + RTS | 40mS + RTS | 16mS + RTS | 4mS + RTS |
| -3dB Frequency | 3Hz | 13Hz | 16Hz | 26Hz | 66Hz | 262Hz |
| Effective Resolution | 16 bits | 16 bits | 16 bits | 16 bits | 15 bits | 10 bits |

(1) Integer mode must be used for RTS values lower than 25mS. The minimum RTS value for the module will be dependent on the channel with the lowest notch filter setting.

(2) In mV mode, 50mS minimum, if linearizing.

(3) Worst case settling time to 100% of a step change would include 0-100% step response time plus one RTS sample time.

To see how to choose a Notch Filter, see page 10-11.

## Real Time Sampling

This parameter instructs the module to scan its input channels and obtain all available data. After the channels are scanned, the module multicasts that data.

During module configuration, you specify a Real Time Sampling (RTS) period and a Requested Packet Interval (RPI) period. These features both instruct the module to multicast data, but only the RTS feature instructs the module to scan its channels before multicasting.

For more information on Real Time Sampling, see page 2-4. For an example of how to set the RTS rate, see page 10-10.

## Underrange/Overrange Detection

This feature detects when a temperature measuring input module is operating beyond limits set by the input range. For example, If you are using the 1756-IR6I module in the 2Ω-1000Ω input range and the module resistance increases to 1050Ω, the Overrange detection detects this condition.

Table 6.6 lists the input ranges of non-isolated input modules and the lowest/highest signal available in each range before the module detects an underrange/overrange condition:

**Table 6.6 Low and High Signal Limits on Temperature Measuring Input Modules**

| Input module: | Available range: | Lowest signal in range: | Highest signal in range: |
|---|---|---|---|
| 1756-IR6I | 1Ω – 487Ω | 0.859068653Ω | 507.862Ω |
| | 2Ω – 1000Ω | 2Ω | 1016.502Ω |
| | 4Ω – 2000Ω | 4Ω | 2033.780Ω |
| | 8Ω – 4020Ω | 8Ω | 4068.392Ω |
| 1756-IT6I and 1756-IT6I2 | -12mV to +30mV | -15.80323mV | 31.396mV |
| | -12mV to +78mV | -15.15836mV | 79.241mV |

## Digital Filter

**IMPORTANT** The digital filter is only available in applications using floating point mode.

The digital filter smooths input data noise transients on **each input channel**. This value specifies the time constant for a digital first order lag filter on the input. It is specified in units of milliseconds. A value of 0 disables the filter.

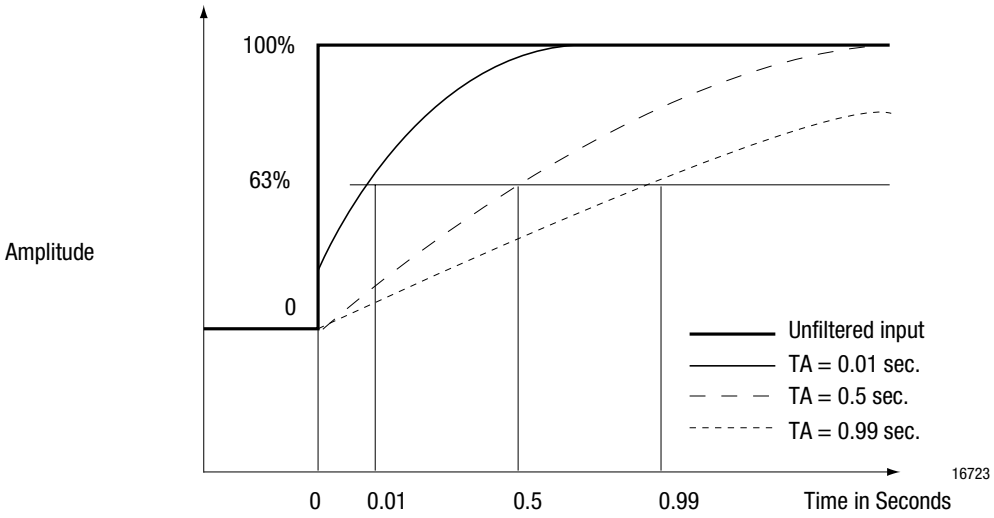
The digital filter equation is a classic first order lag equation.

$$Yn = Yn\text{-}1 + \frac{[\Delta t]}{\Delta t + TA} (X_n - Y_n\text{-}1)$$

Yn = present output, filtered peak voltage (PV)
Yn-1 = previous output, filtered PV
$\Delta t$ = module channel update time (seconds)
TA = digital filter time constant (seconds)
Xn = present input, unfiltered PV

Using a step input change to illustrate the filter response, you can see that when the digital filter time constant elapses, 63.2% of the total response is reached. Each additional time constant achieves 63.2% of the remaining response. For more information, see Figure 6.1.

**Figure 6.1**




To see how to set the Digital Filter, see page 10-10.

## Process Alarms

Process alarms alert you when the module has exceeded configured high or low limits for **each channel**. You can latch process alarms. These are set at four user configurable alarm trigger points:

- High high
- High
- Low
- Low low

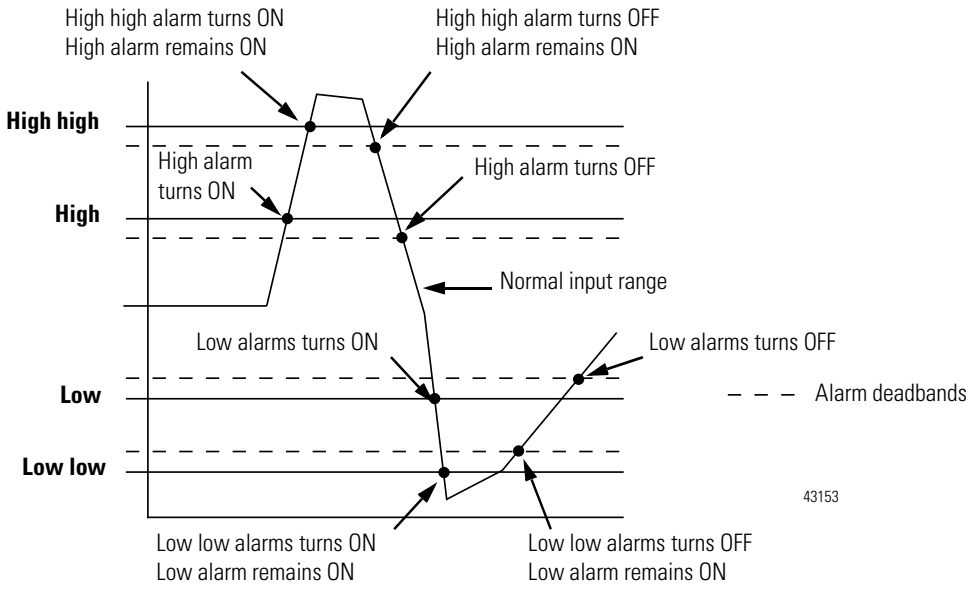
**IMPORTANT** Process alarms are only available in applications using floating point mode. The values for each limit are entered in scaled engineering units.

### *Alarm Deadband*

You may configure an **Alarm Deadband** to work with these alarms. The deadband allows the process alarm status bit to remain set, despite the alarm condition disappearing, as long as the input data remains within the deadband of the process alarm.

Figure 6.2 shows input data that sets each of the four alarms at some point during module operation. In this example, Latching is disabled; therefore, each alarms turns OFF when the condition that caused it to set ceases to exist.

**Figure 6.2**




To see how to set Process Alarms, see page 10-10.

## Rate Alarm

**IMPORTANT** Prior to RSLogix 5000, version 12 and module firmware revision 1.10, the rate alarm does not function correctly when linearizing (i.e. non-ohms or non-millivolt input range) temperature inputs on the 1756-IR6I, 1756-IT6I and 1756-IT6I2 modules.

To correctly use the rate alarm for a non-ohm input on the 1756-IR6I module and a non-millivolt input on the 1756-IT6I and 1756-IT6I2 modules, make sure you use RSLogix 5000, version 12 and module firmware 1.10 for these modules.

The rate alarm triggers if the rate of change between input samples for **each channel** exceeds the specified trigger point for that channel. This feature is **only available in applications using floating point**.

**EXAMPLE** If you set a 1756-IT6I2 module (with normal scaling in celsius) to a rate alarm of 100.1°C/S, the rate alarm only trigger if the difference between measured input samples changes at a rate > 100.1°C/S.

If the module's RTS is 100 ms (i.e. sampling new input data every 100ms) and at time 0, the module measures 355°C and at time 100ms measures 363°C, the rate of change is (363°C - 355°C) / (100mS) = 80°C/S. The rate alarm would not set as the change is less than the trigger point of 100.1°C/s.

If the next sample taken is 350.3°C, the rate of change is (350.3°C-363°C)/(100mS)=-127°C/S. The absolute value of this result is > 100.1°C/S, so the rate alarm will set. Absolute value is used because rate alarm checks for the magnitude of the rate of change being beyond the trigger point, whether a positive or negative excursion.

To see how to set the Rate Alarm, see page 10-10.

## 10 Ohm Offset

With this feature, you can compensate for a small offset error in a 10 ohm copper RTD. Values can range from -0.99 to +0.99 ohms in units of 0.01 ohms. For example, if the resistance of a copper RTD used with a channel is 9.74 ohms at 25°C, you would enter -0.26 in this field. To see how to set the 10 Ohm Offset, see page 10-14.

## Wire Off Detection

The ControlLogix temperature measuring modules alert you when a wire has been disconnected from one of their channels. When a wire off condition occurs, two events occur:

- Input data for that channel changes to a specific scaled value
- A fault bit is set in the owner-controller which may indicate the presence of a wire off condition

Because these modules can each be used in various applications, differences exist when a wire off condition is detected in each application. Table 6.7 lists the differences that occur when a wire off condition occurs in various applications.

**Table 6.7**

| In this application: | the following causes a wire off condition: | And if the wire off condition is detected, the following occurs: |
|---|---|---|
| 1756-IR6I Module in Temperature Applications | Either of the following:<br>1. When any combination of wires are disconnected from the module, except the loss of the wire from terminal A only (see Figure 6.8 on page 6-19 and Figure 6.9 on page 6-19).<br>2. When only the wire connected to terminal A (see Figure 6.8 on page 6-19 and Figure 6.9 on page 6-19) is lost | If possibility #1 (in the previous column) is the cause:<br>• input data for the channel changes to the lowest scaled temperature value associated with the selected RTD type<br>• the ChxUnderrange (x=channel number) tag is set to 1<br><br>If possibility #2 (in the previous column) is the cause:<br>• input data for the channel changes to the highest scaled temperature value associated with the selected RTD type<br>• the ChxOverrrange (x=channel number) tag is set to 1 |
| 1756-IR6I Module in Ohms Applications | Either of the following:<br>1. When any combination of wires are disconnected from the module, except the loss of a wire from terminal A by itself (see Figure 6.8 on page 6-19 and Figure 6.9 on page 6-19)<br>2. When only the wire connected to terminal A (see Figure 6.8 on page 6-19 and Figure 6.9 on page 6-19) is lost | If possibility #1 (in the previous column) is the cause:<br>• input data for the channel changes to the lowest scaled ohm value associated with the selected ohms range<br>• the ChxUnderrange (x=channel number) tag is set to 1<br><br>If possibility #2 (in the previous column) is the cause:<br>• input data for the channel changes to the highest scaled ohm value associated with the selected ohms range<br>• the ChxOverrange (x=channel number) tag is set to 1 |
| 1756-IT6I or 1756-IT6I2 Module in Temperature Applications | A wire is disconnected from the module. | • input data for the channel changes to the highest scaled temperature value associated with the selected thermocouple type<br>• the ChxOverrange (x=channel number) tag is set to 1 |
| 1756-IT6I Module or 1756-IT6I2 in Millivolt Applications | | • input data for the channel changes to the scaled value associated with the **overrange** signal value of the selected operational range in floating point mode (maximum possible scaled value) or 32,767 counts in integer mode<br>• the ChxOverrange (x=channel number) tag is set to 1 |

For more information about tags in the tag editor, see Appendix B.

## Sensor Type

Three analog modules, the RTD (1756-IR6I) and Thermocouple (1756-IT6I and 1756-IT6I2), allow you to configure a **sensor type for each channel** that linearizes the analog signal into a temperature value. The RTD module linearizes ohms into temperature and the Thermocouple modules linearize millivolts into temperature.

**IMPORTANT** Sensor types are only available in applications using floating point mode.

Also, these modules can only linearize signals to temperature values in the floating point mode.

Table 6.8 lists the sensors that are available for your application:

**Table 6.8 Available Sensors for Temperature Measuring Modules**

| Module: | Available sensors or thermocouples: |
|---|---|
| 1756-IR6I | 10Ω - Copper 427 type<br>100Ω - Platinum 385, Platinum 3916, and Nickel 618 types<br>120Ω - Nickel 618 and Nickel 672 types<br>200Ω - Platinum 385, Platinum 3916, and Nickel 618 types<br>500Ω - Platinum 385, Platinum 3916, and Nickel 618 types<br>1000Ω - Platinum 385 and Platinum 3916 types |
| 1756-IT6I | B, E, J, K, R, S, T, N, C |
| 1756-IT6I2 | B, E, J, K, R, S, T, N, C, D, TXK/XK (L) |

When you select any of the sensor or thermocouple types listed Table 6.8 during configuration, RSLogix 5000 uses the default values in the scaling box:

**Table 6.9 Default Signal and Engineering Values in RSLogix 5000**

| 1756-IR6I | | 1756-IT6I and 1756-IT6I2 | |
|---|---|---|---|
| Low signal = 1 | Low engineering = 1 | Low signal = -12 | Low engineering = -12 |
| High signal = 487 | High engineering = 487 | High signal = +78 | High engineering = +78 |

**IMPORTANT** The module sends back temperature values over the entire sensor range as long as the Low signal value equals the Low engineering value and the High signal value equals the High engineering value. The actual numbers used in the signal and engineering fields are irrelevant as long as they are equal.

Table 6.10 displays the temperature range for each 1756-IR6I sensor type.

**Table 6.10 Temperature Limits for 1756-IR6I Sensor Types**

| 1756-IR6I Sensor: | Copper 427 | Nickel 618 | Nickel 672 | Platinum 385 | Platinum 3916 |
|---|---|---|---|---|---|
| Low temperature | -200.0°C<br>-328.0°F | -60.0°C<br>-76.0°F | -80.0°C<br>-112.0°F | -200.0°C<br>-328.0°F | -200.0°C<br>-328.0°F |
| High temperature | 260.0°C<br>500.0°F | 250.0°C<br>482.0°F | 320.0°C<br>608.0°F | 870.0°C<br>1598.0°F | 630.0°C<br>1166.0°F |

To see how to choose an RTD sensor type, see page 10-14.

Table 6.11 displays the temperature range for each 1756-IT6I and 1756-IT6I2 sensor type.

**Table 6.11 Temperature Limits for 1756-IT6I and 1756-IT6I2 Sensor Types**

| Thermocouple: | B | C | E | J | K | N | R | S | T | D[1] | TXK/XK (L)[1] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Low temperature | 300.0°C<br>572.0°F | 0.0°C<br>32.0°F | -270.0°C<br>-454.0°F | -210.0°C<br>-346.0°F | -270.0°C<br>-454.0°F | -270.0°C<br>-454.0°F | -50.0°C<br>-58.0°F | -50.0°C<br>-58.0°F | -270.0°C<br>-454.0°F | 0°C<br>32.0°F | -200°C<br>-328°F |
| High temperature | 1820.0°C<br>3308.0°F | 2315.0°C<br>4199.0°F | 1000.0°C<br>1832.0°F | 1200.0°C<br>2192.0°F | 1372.0°C<br>2502.0°F | 1300.0°C<br>2372.0°F | 1768.1°C<br>3215.0°F | 1768.1°C<br>3215.0°F | 400.0°C<br>752.0°F | 2320°C<br>4208°F | 800°C<br>1472°F |

(1) Sensor types D and L are only available on the 1756-IT6I2 module.

**IMPORTANT** Table 6.11 lists temperature limits for sensors using the -12 to 78mV range only. When the -12 to 30mV range is used, temperature limits are truncated to the temperature value that corresponds to 30mV.

To see how to choose an thermocouple sensor type, see page 10-15.

### Temperature Units

The 1756-IR6I, 1756-IT6I and 1756-IT6I2 modules provide the choice of working in Celsius or Fahrenheit. This choice affects all channels per module.

To see how to choose Temperature Units, see page 10-15.

## Differences Between the 1756-IT6I and 1756-IT6I2 Modules

In addition to offering access to two more thermocouple types (i.e. types D and TXK/XK [L]), the 1756-IT6I2 module offers:

- greater cold junction compensation accuracy

  While the 1756-IT6I module can report cold junction temperature differences between channels as high as 3°C from the actual temperature, the 1756-IT6I2 module, because it has two CJSs, reduces the potential channel value variance from actual temperature to 0.3°C.

  Table 6.12 lists channel value variance from actual temperature, depending on the type of cold junction compensation used.

**Table 6.12**

| If you use this module: | with this type of cold junction compensation: | The channel value variance from actual temperature is: |
|---|---|---|
| 1756-IT6I2 | 2 cold junction sensors on an RTB | +/-0.3°C |
| 1756-IT6I2 | IFM | +/-0.3°C |
| 1756-IT6I | 1 cold junction sensor on an RTB | +/-3.2°C |
| 1756-IT6I | IFM | +/-0.3°C |

  For more information on Cold Junction Compensation, see page 6-13.

- improved module accuracy. For more information on the Improved Module Accuracy available with the 1756-IT6I2 module, see page 6-16.

## Cold Junction Compensation

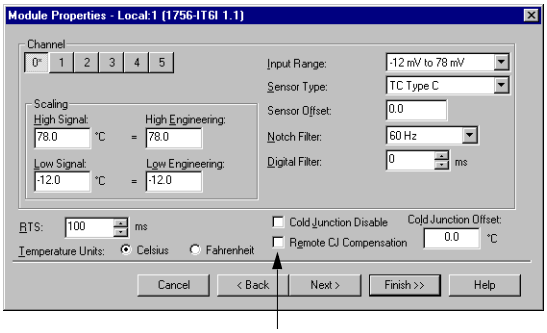
When using the Thermocouple (1756-IT6I and 1756-IT6I2) modules, you must account for additional voltage that may alter the input signal. The junction of thermocouple field wires with the screw terminations of an RTB or IFM generates a small voltage. This thermoelectric effect alters the input signal.

To accurately compensate the input signal from your module, you must use a cold junction sensor (CJS) to account for the increased voltage. Because there are differences if you choose to connect sensors via an RTB or IFM, you must configure the module (via RSLogix 5000) to work with the type of CJS used in your application.

### *Connecting a Cold Junction Sensor Via a Removable Terminal Block*

When you connect a CJS to your thermocouple via an RTB, the module internally estimates the temperature deviation between module terminations to make cold junction compensation. The 1756-IT6I module uses one (1) CJS in the middle of the module to estimate temperature deviation. The 1756-IT6I2 module uses two (2) CJSs at the top and bottom of the module to estimate temperature deviation; this usage of multiple sensors results in increased accuracy.

If you connect a CJS via an IFM, configure the module as shown in the screen below.



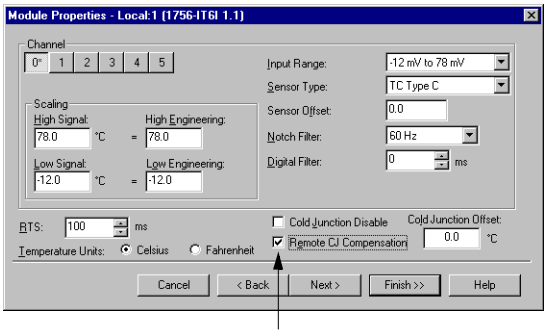

If you are using a CJS on an RTB, leave all fields unchecked,

To see how to connect a CJS to either thermocouple module, see page 6-14.

### *Connecting a Cold Junction Sensor Via an Interface Module*

The IFMs use an isothermal bar to maintain a steady temperature at all module terminations.

If you connect a CJS via an IFM, configure the module as shown in the screen below.

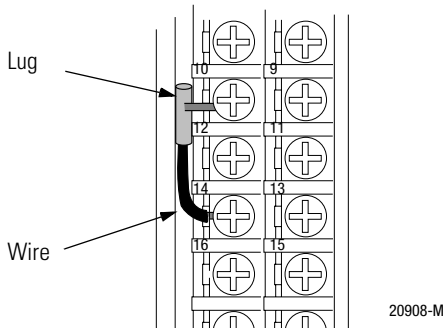



If you are using a CJS on an IFM, check the Remote CJ Compensation field.

### *Connecting a Cold Junction Sensor to the 1756-IT6I Module*

You must connect the CJS to the 1756-IT6I module at terminals 10 and 14. To ease installation, wire terminal #12 (RTN-3) before connecting the cold junction sensor.

**Figure 6.3**

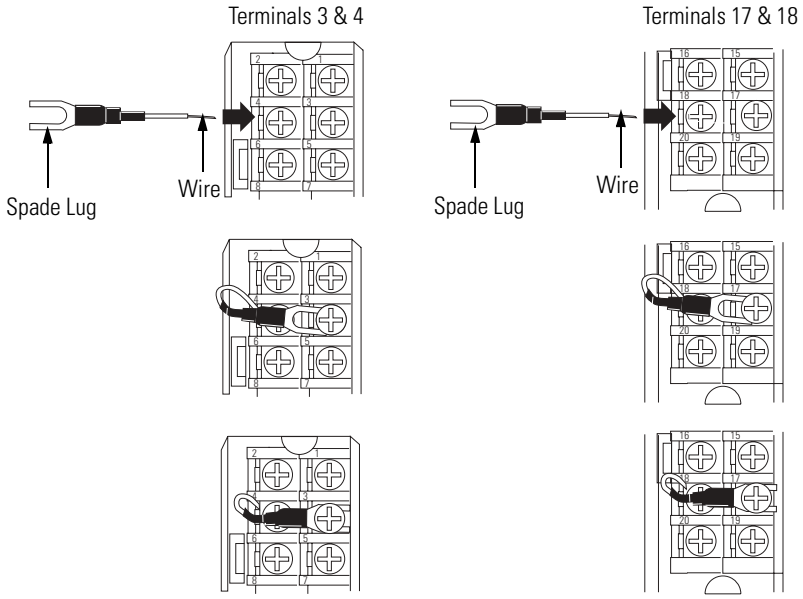



The CJS is part number 94238301. Contact your local distributor or Rockwell Automation sales representative to order additional sensors.

### *Connecting a Cold Junction Sensor to the 1756-IT6I2 Module*

You must connect two CJSs to the 1756-IT6I2 when using an RTB. The additional CJS offers greater accuracy when measuring temperature on the module. Connect the cold junction sensors to terminals 3 & 4 and 17 & 18 as shown in Figure 6.4.

**Figure 6.4**




The CJS for the 1756-IT6I2 module is part number 94286501. Contact your local distributor or Rockwell Automation sales representative to order additional sensors.

### *Cold Junction Disable*

RSLogix 5000 offers an option to disable cold junction compensation. If used, this option removes all cold junction compensation on all module channels. Typically, this option is only used in systems that have no thermoelectric effect (e.g. test equipment in a controlled lab).

In most applications, we recommend that you do not use the Cold Junction Disable option.

*Cold Junction Offset*

RSLogix 5000 also offers an option to make module-wide adjustments to cold junction compensation values. If you know that your cold junction compensation values are consistently inaccurate by some level (e.g. 1.2°C), you can set the Cold Junction Offset to -1.2° to account for this inaccuracy.

## Improved Module Accuracy

The 1756-IT6I2 also offers an improved Gain Drift with Temperature and Module Error over Temperature Range specifications when compared to the 1756-IT6I module. Table 6.13 highlights the differences. For a full listing of these module's specifications, see Appendix A.

**Table 6.13**

| Catalog Number: | Gain Drift with Temperature:(1) | Module Error over Temperature Range:(1) |
|---|---|---|
| 1756-IT6I | 80 ppm | 0.5% |
| 1756-IT6I2 | 25 ppm | 0.15% |

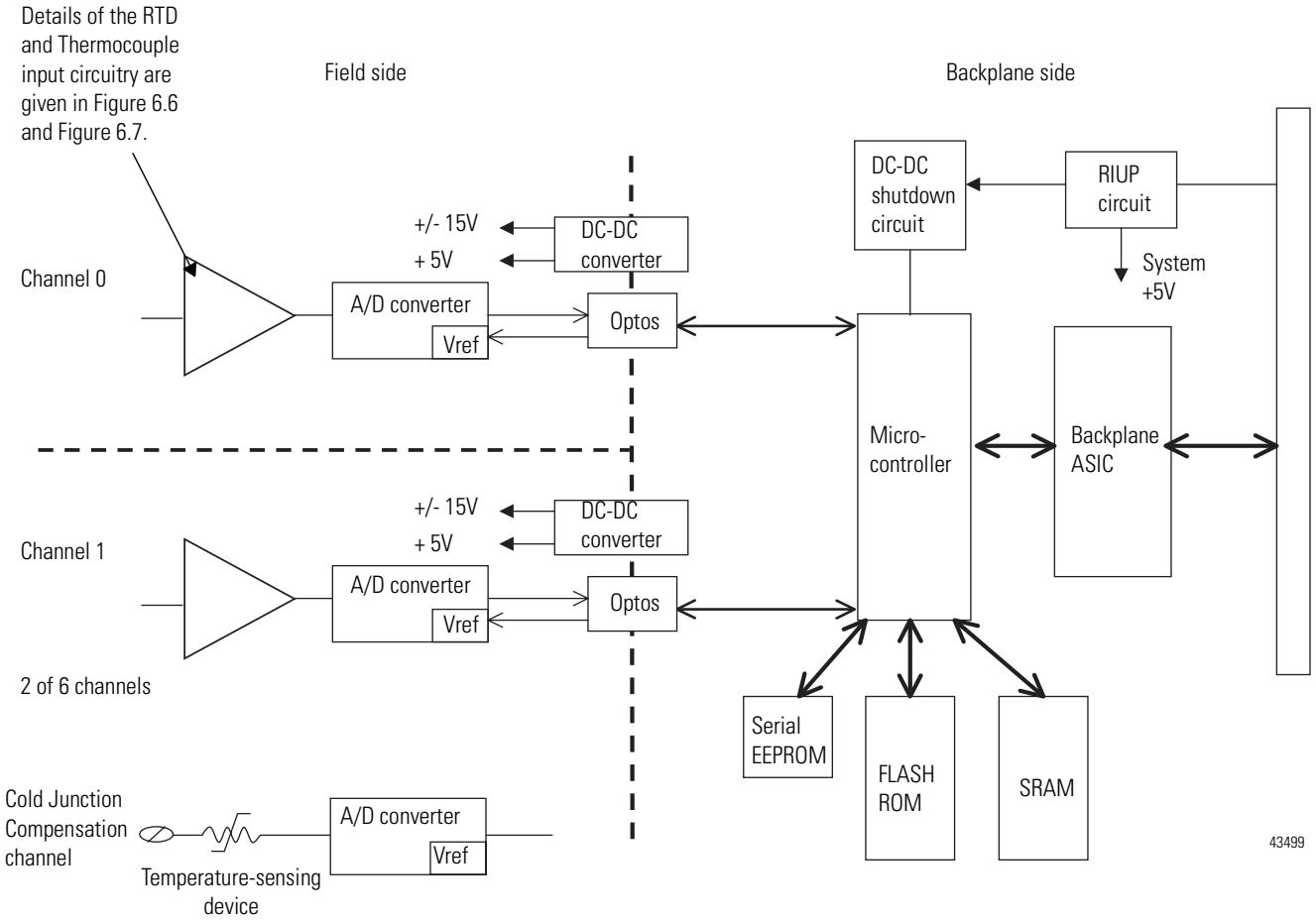
(1) To read a detailed explanation of this specification, see Appendix E.

# Using Module Block and Input Circuit Diagrams

This section shows the 1756-IR6I, 1756-IT6I and 1756-IT6I2 modules' block diagrams and input circuit diagrams.

## Module Block Diagram

**Figure 6.5 1756-IR6I, 1756-IT6I and 1756-IT6I2 Module Block Diagram**




**IMPORTANT**: The cold junction compensation (CJC) channel is used on thermocouple modules only. The 1756-IT6I module has one CJC channel, and the 1756-IT6I2 module has two CJC channels.

= Channel isolation

# Field Side Circuit Diagrams

**Figure 6.6 1756-IR6I Input Circuit**

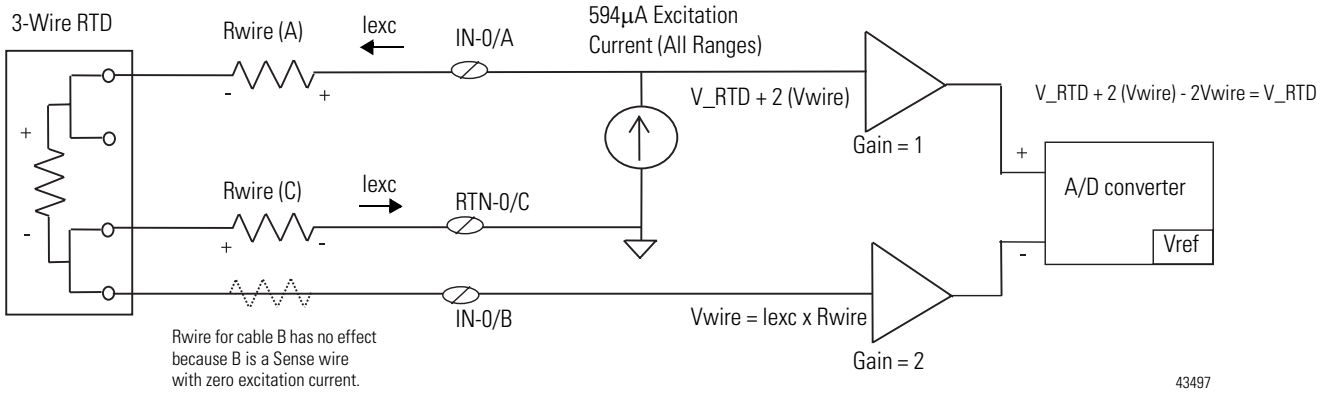
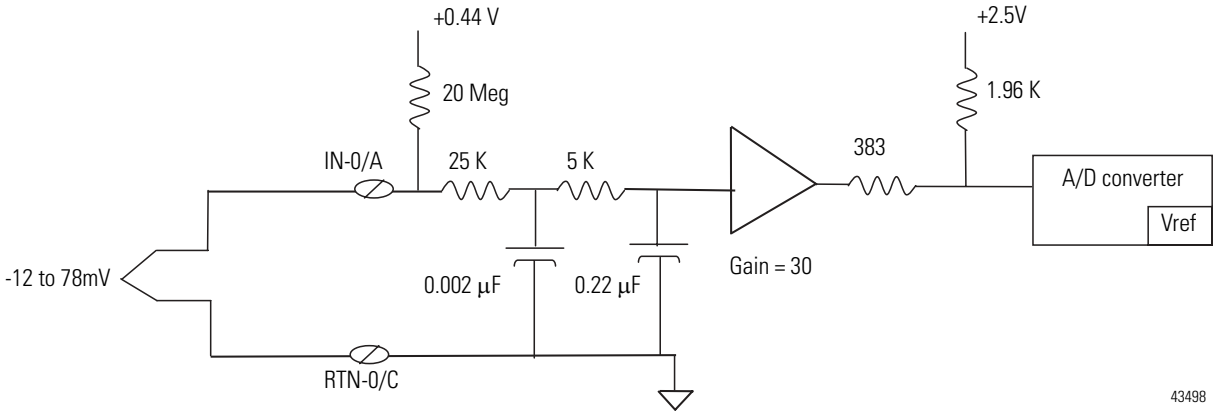
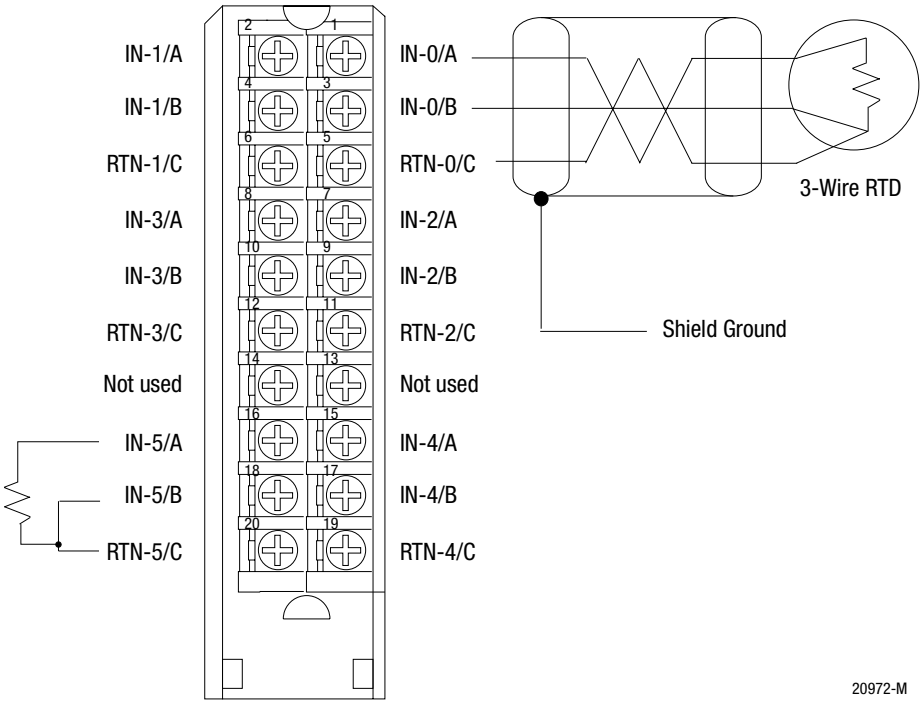



**Figure 6.7 1756-IT6I and 1756-IT6I2 Input Circuit**



# Wiring the 1756-IR6I Module

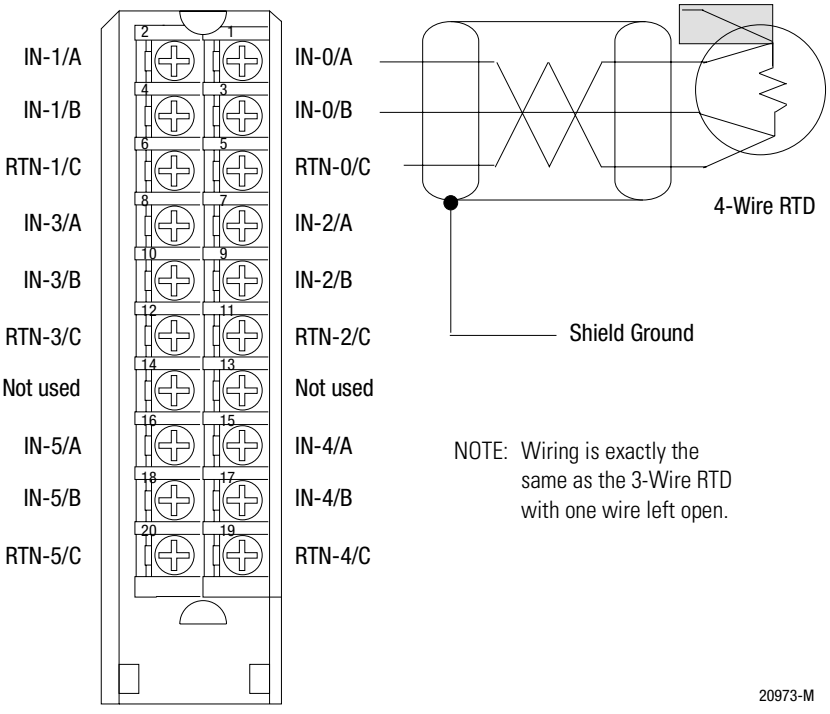
**Figure 6.8 1756-IR6I 3-Wire RTD wiring example**




**IMPORTANT**: For 2-wire resistor applications including calibration, make sure IN-x/B and RTN-x/C are shorted together as shown.

**NOTE**: Do not connect more than 2 wires to any single terminal.

**Figure 6.9 1756-IR6I 4-Wire RTD wiring example**

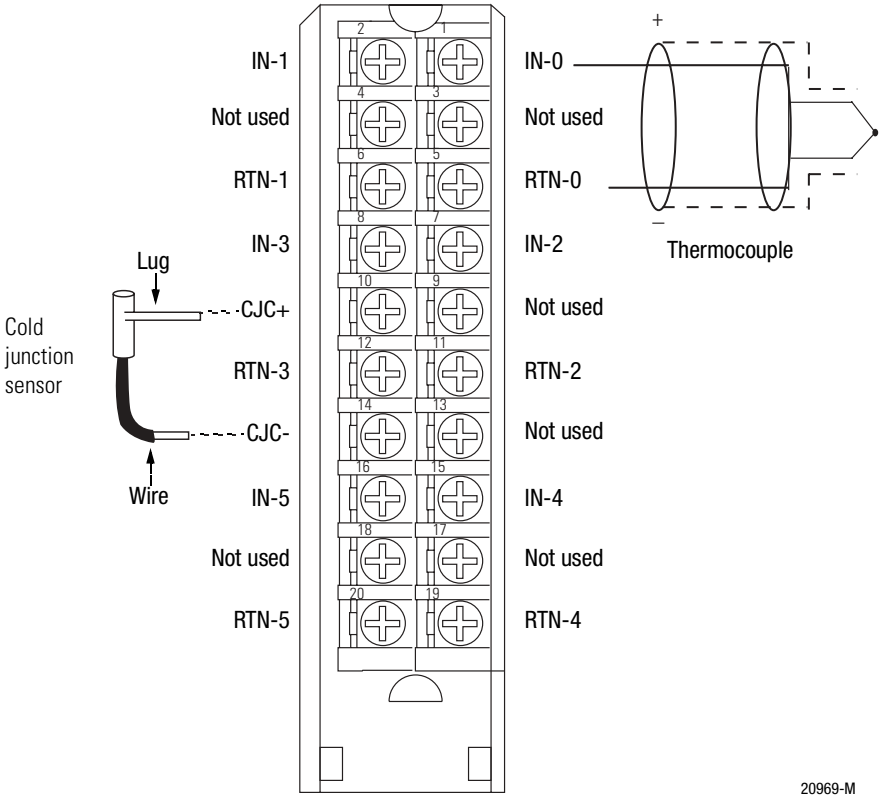



NOTE: Wiring is exactly the same as the 3-Wire RTD with one wire left open.

**NOTE**: Do not connect more than 2 wires to any single terminal.

# Wiring the 1756-IT6I Module

**Figure 6.10 1756-IT6I wiring example**

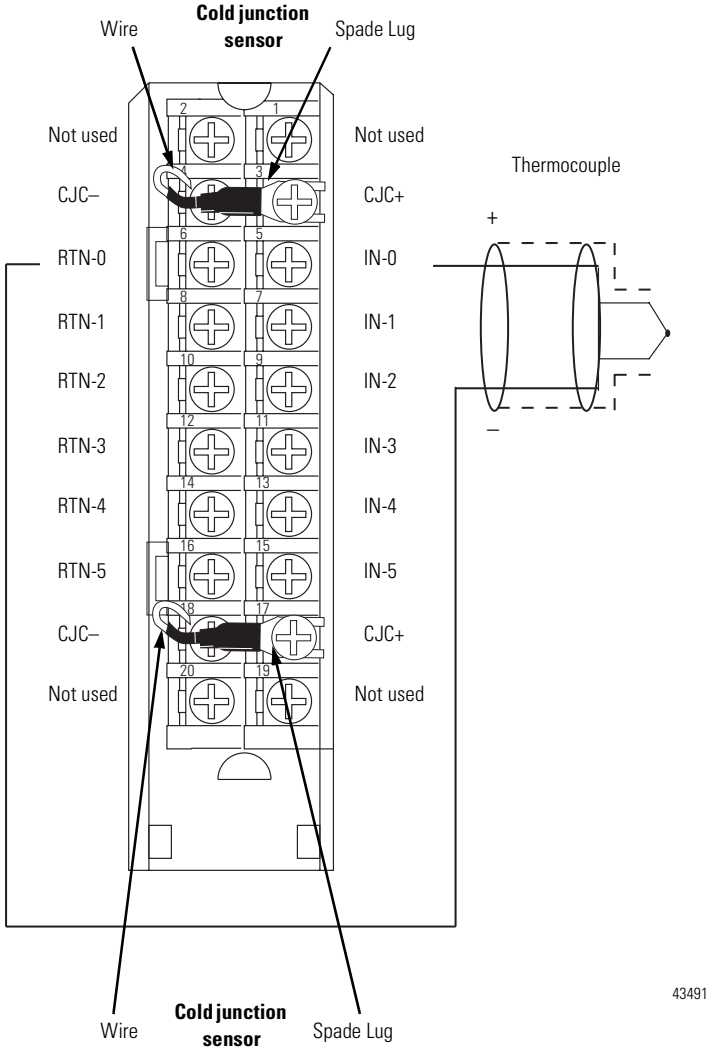



**NOTES**:

1. Do not connect more than 2 wires to any single terminal.
2. The part number for the cold junction sensor used on the 1756-IT6I module is 94238301.

# Wiring the 1756-IT6I2 Module

**Figure 6.11 1756-IT6I2 wiring example**




**NOTES**:

1. Do not connect more than 2 wires to any single terminal.
2. The part number for the cold junction sensor used on the 1756-IT6I module is 94286501.

## 1756-IR6I, 1756-IT6I and 1756-IT6I2 Fault and Status Reporting

The 1756-IR6I, 1756-IT6I and 1756-IT6I2 modules multicast status/fault data to the owner/listening controller with its channel data. The fault data is arranged in such a manner as to allow the user to choose the level of granularity he desires for examining fault conditions.

Three levels of tags work together to provide increasing degree of detail as to the specific cause of faults on the module.

Table 6.14 lists tags that can be examined in ladder logic to indicate when a fault has occurred:

**Table 6.14**

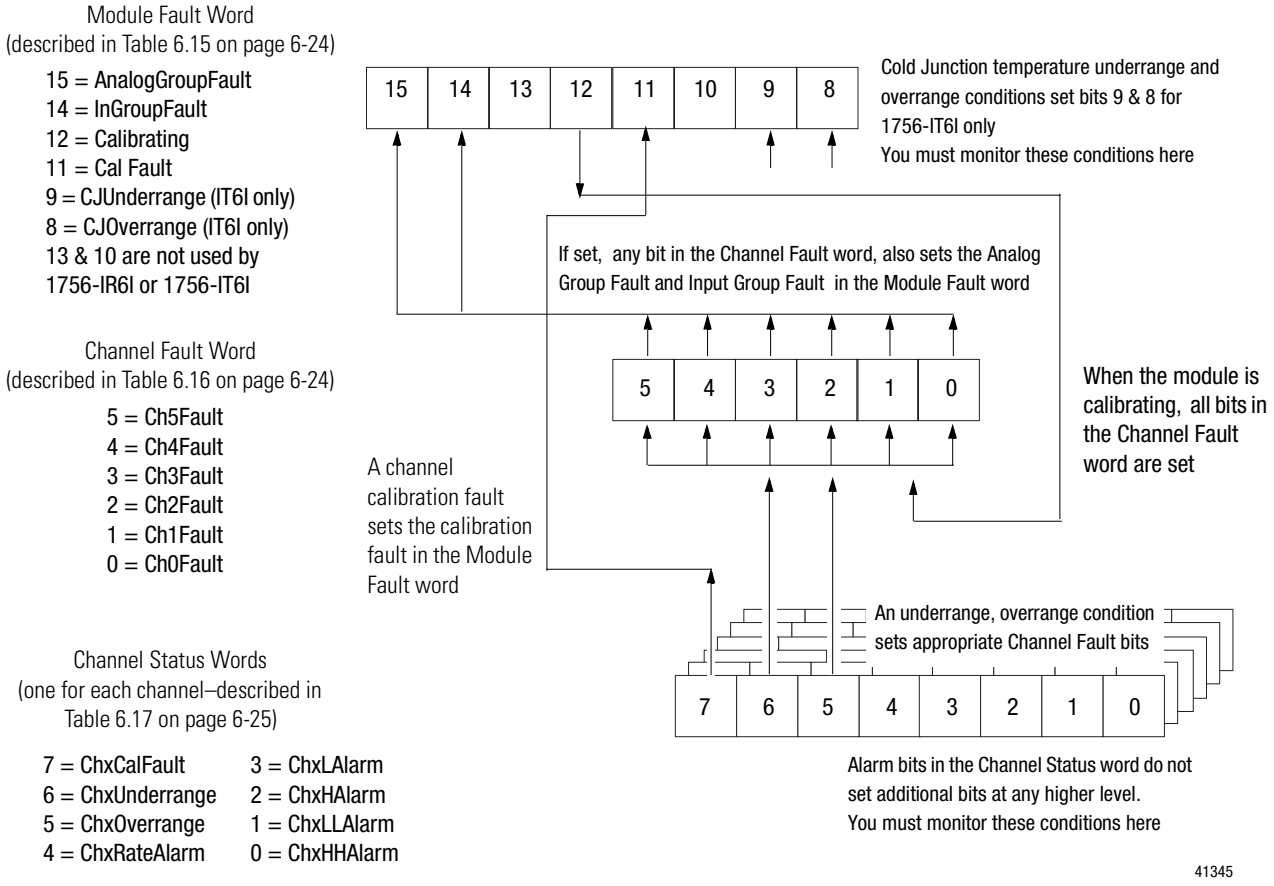
| Tag: | Description: |
|---|---|
| Module Fault Word | This word provides fault summary reporting. Its tag name is ModuleFaults. |
| Channel Fault Word | This word provides underrange, overrange and communications fault reporting. Its tag name is ChannelFaults. |
| Channel Status Words | This word provides individual channel underrange and overrange fault reporting for process alarms, rate alarms and calibration faults. Its tag name is ChxStatus. |

**IMPORTANT** Differences exist between floating point and integer modes as they relate to module fault reporting. These differences are explained in the following two sections.

# Fault Reporting in Floating Point Mode

Figure 6.12 offers an overview of the fault reporting process in floating point mode.

**Figure 6.12**


Module Fault Word
(described in Table 6.15 on page 6-24)
15 = AnalogGroupFault
14 = InGroupFault
12 = Calibrating
11 = Cal Fault
9 = CJUnderrange (IT6I only)
8 = CJOverrange (IT6I only)
13 & 10 are not used by
1756-IR6I or 1756-IT6I
15 14 13 12 11 10 9 8
Cold Junction temperature underrange and overrange conditions set bits 9 & 8 for 1756-IT6I only
You must monitor these conditions here
If set, any bit in the Channel Fault word, also sets the Analog Group Fault and Input Group Fault in the Module Fault word
Channel Fault Word
(described in Table 6.16 on page 6-24)
5 = Ch5Fault
4 = Ch4Fault
3 = Ch3Fault
2 = Ch2Fault
1 = Ch1Fault
0 = Ch0Fault
5 4 3 2 1 0
When the module is calibrating, all bits in the Channel Fault word are set
A channel calibration fault sets the calibration fault in the Module Fault word
An underrange, overrange condition sets appropriate Channel Fault bits
Channel Status Words
(one for each channel–described in Table 6.17 on page 6-25)
7 = ChxCalFault
6 = ChxUnderrange
5 = ChxOverrange
4 = ChxRateAlarm
3 = ChxLAlarm
2 = ChxHAlarm
1 = ChxLLAlarm
0 = ChxHHAlarm
7 6 5 4 3 2 1 0
Alarm bits in the Channel Status word do not set additional bits at any higher level.
You must monitor these conditions here
41345

## Module Fault Word Bits – Floating Point Mode

Bits in this word provide the highest level of fault detection. A nonzero condition in this word reveals that a fault exists on the module. You can examine further down to isolate the fault.

Table 6.15 lists tags that are found in the Module Fault Word:

**Table 6.15**

| Tag: | Description: |
|---|---|
| Analog Group Fault | This bit is set when any bits in the Channel Fault word are set. Its tag name is AnalogGroupFault. |
| Input Group Fault | This bit is set when any bits in the Channel Fault word are set. Its tag name is InputGroup. |
| Calibrating | This bit is set when any channel is being calibrated. When this bit is set, all bits in the Channel Fault word are set. Its tag name is Calibrating. |
| Calibration Fault | This bit is set when any of the individual Channel Calibration Fault bits are set. Its tag name is CalibrationFault. |
| Cold Junction Underrange – 1756-IT6I and 1756-IT6I2only | This bit is set when the ambient temperature around the Cold Junction Sensor is below $0^{o}$C. Its tag name is CJUnderrange. |
| Cold Junction Overrange – 1756-IT6I and 1756-IT6I2only | This bit is set when the ambient temperature around the Cold Junction Sensor is above $86^{o}$C. Its tag name is CJOverrange. |

## Channel Fault Word Bits – Floating Point Mode

During normal module operation, bits in the Channel Fault word are set if any of the respective channels has an Under or Overrange condition. Checking this word for a nonzero value is a quick way to check for Under or Overrange conditions on the module.

Table 6.16 lists the conditions that set **all** Channel Fault word bits:

**Table 6.16**

| This condition sets all Channel Fault word bits: | And causes the module to display the following in the Channel Fault word bits: |
|---|---|
| A channel is being calibrated | "003F" for all bits |
| A communications fault occurred between the module and its owner-controller | "FFFF" for all bits |

Your logic can monitor the Channel Fault Word bit for a particular input to determine the state of that point.

## Channel Status Word Bits – Floating Point Mode

Any of the 6 Channel Status words, one for each channel, will display a nonzero condition if that particular channel has faulted for the conditions listed below. Some of these bits set bits in other Fault words. When the Underrange and Overrange bits (bits 6 & 5) in any of the words are set, the appropriate bit is set in the Channel Fault word.

When the Calibration Fault bit (bit 7) is set in any of the words, the Calibration Fault bit (bit 9) is set in the Module Fault word. Table 6.17 lists the conditions that set each of the word bits.

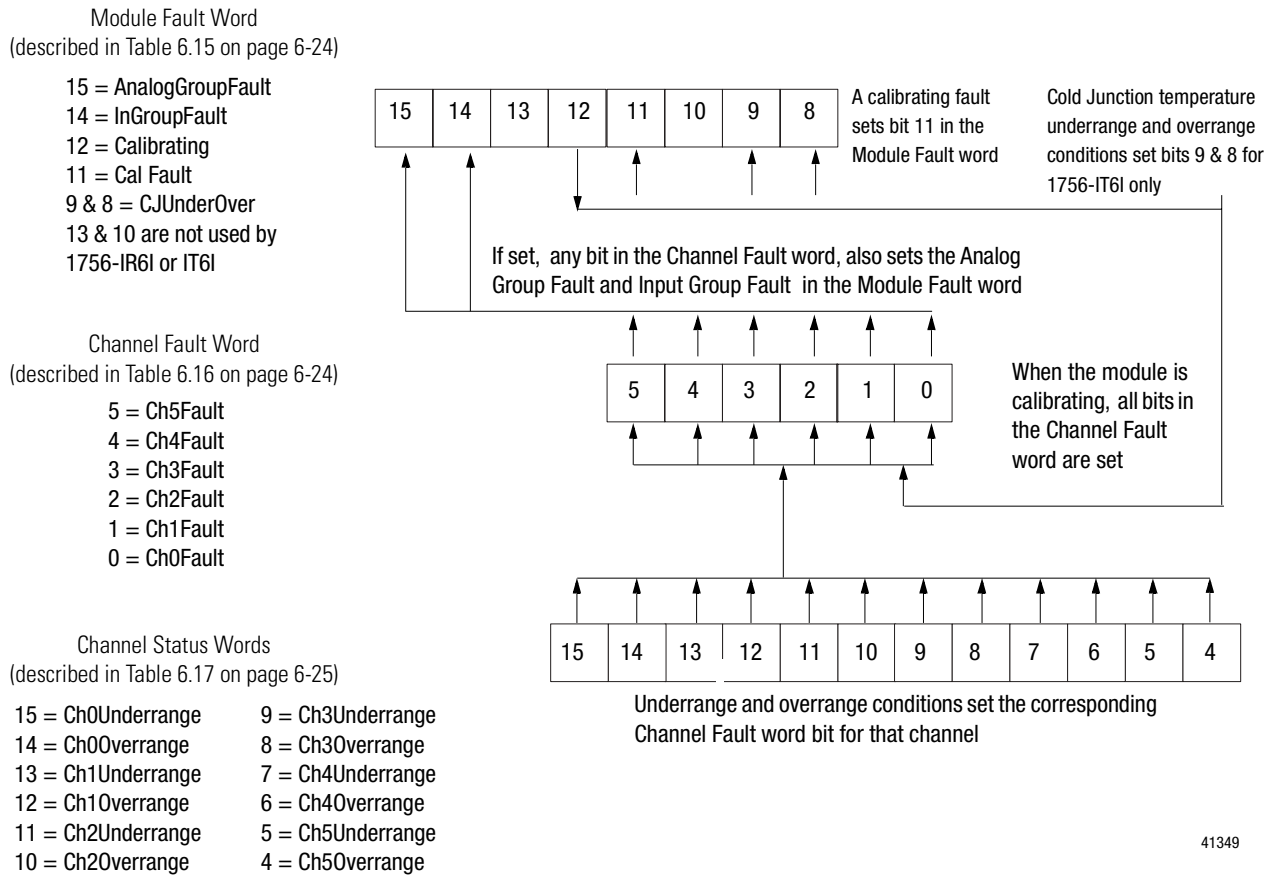
**Table 6.17**

| Tag (Status word): | Bit: | Event that sets this tag: |
|---|---|---|
| ChxCalFault | Bit 7 | This bit is set if an error occurs during calibration for that channel, causing a bad calibration. This bit also sets bit 9 in the Module Fault word. |
| Underrange | Bit 6 | This bit is set when the input signal at the channel is less than or equal to the minimum detectable signal. For more information on the minimum detectable signal for each module, see Table 6.6 on page 6-5. This bit also sets the appropriate bit in the Channel Fault word. |
| Overrange | Bit 5 | This bit is set when the input signal at the channel is greater than or equal to the maximum detectable signal. For more information on the maximum detectable signal for each module, see Table 6.6 on page 6-5. This bit also sets the appropriate bit in the Channel Fault word. |
| ChxRateAlarm | Bit 4 | This bit is set when the input channel's rate of change exceeds the configured Rate Alarm parameter. It remains set until the rate of change drops below the configured rate. If latched, the alarm remains set until it is unlatched. |
| ChxLAlarm | Blt 3 | This bit is set when the input signal moves beneath the configured Low Alarm limit. It remains set until the signal moves above the configured trigger point. If latched, the alarm will remain set until it is unlatched. If a deadband is specified, the alarm will also remain set as long as the signal remains within the configured deadband. |
| ChxHAlarm | Bit 2 | This bit is set when the input signal moves above the configured High Alarm limit. It remains set until the signal moves below the configured trigger point. If latched, the alarm remains set until it is unlatched. If a deadband is specified, the alarm also remains set as long as the signal remains within the configured deadband. |
| ChxLLAlarm | Bit 1 | This bit is set when the input signal moves beneath the configured Low-Low Alarm limit. It remains set until the signal moves above the configured trigger point. If latched, the alarm remains set until it is unlatched. If a deadband is specified, the alarm also remains latched as long as the signal remains within the configured deadband. |
| ChxHHAlarm | Bit 0 | This bit is set when the input signal moves above the configured High-High Alarm limit. It remains set until the signal moves below the configured trigger point. If latched, the alarm remains set until it is unlatched. If a deadband is specified, the alarm also remains latched as long as the signal remains within the configured deadband. |

# Fault Reporting in Integer Mode

Figure 6.13 offers an overview of the fault reporting process in integer mode.

**Figure 6.13**


Module Fault Word
(described in Table 6.15 on page 6-24)
15 = AnalogGroupFault
14 = InGroupFault
12 = Calibrating
11 = Cal Fault
9 & 8 = CJUnderOver
13 & 10 are not used by
1756-IR6I or IT6I
15 14 13 12 11 10 9 8
A calibrating fault sets bit 11 in the Module Fault word
Cold Junction temperature underrange and overrange conditions set bits 9 & 8 for 1756-IT6I only
If set, any bit in the Channel Fault word, also sets the Analog Group Fault and Input Group Fault in the Module Fault word
Channel Fault Word
(described in Table 6.16 on page 6-24)
5 = Ch5Fault
4 = Ch4Fault
3 = Ch3Fault
2 = Ch2Fault
1 = Ch1Fault
0 = Ch0Fault
5 4 3 2 1 0
When the module is calibrating, all bits in the Channel Fault word are set
Channel Status Words
(described in Table 6.17 on page 6-25)
15 = Ch0Underrange
14 = Ch0Overrange
13 = Ch1Underrange
12 = Ch1Overrange
11 = Ch2Underrange
10 = Ch2Overrange
9 = Ch3Underrange
8 = Ch3Overrange
7 = Ch4Underrange
6 = Ch4Overrange
5 = Ch5Underrange
4 = Ch5Overrange
15 14 13 12 11 10 9 8 7 6 5 4
Underrange and overrange conditions set the corresponding Channel Fault word bit for that channel
41349

## Module Fault Word Bits – Integer Mode

In integer mode, Module Fault word bits (bits 15-8) operate exactly as described in floating point mode. Table 6.18 lists tags that are found in the Module Fault Word:

**Table 6.18**

| Tag: | Description: |
|---|---|
| Analog Group Fault | This bit is set when any bits in the Channel Fault word are set. Its tag name is AnalogGroupFault. |
| Input Group Fault | This bit is set when any bits in the Channel Fault word are set. Its tag name is InputGroup. |
| Calibrating | This bit is set when any channel is being calibrated. When this bit is set, all bits in the Channel Fault word are set. Its tag name is Calibrating. |
| Calibration Fault | This bit is set when any of the individual Channel Calibration Fault bits are set. Its tag name is CalibrationFault. |
| Cold Junction Underrange – 1756-IT6I only | This bit is set when the ambient temperature around the Cold Junction Sensor is below $0^{o}$C. Its tag name is CJUnderrange. |
| Cold Junction Overrange – 1756-IT6I only | This bit is set when the ambient temperature around the Cold Junction Sensor is above $86^{o}$C. Its tag name is CJOverrange. |

## Channel Fault Word Bits – Integer Mode

In integer mode, Channel Fault word bits operate exactly as described in floating point mode. Table 6.19 lists the conditions that set **all** Channel Fault word bits:

**Table 6.19**

| This condition sets all Channel Fault word bits: | And causes the module to display the following in the Channel Fault word bits: |
|---|---|
| A channel is being calibrated | "003F" for all bits |
| A communications fault occurred between the module and its owner-controller | "FFFF" for all bits |

Your logic can monitor the Channel Fault Word bit for a particular input to determine the state of that point.

## Channel Status Word Bits – Integer Mode

The Channel Status word has the following differences when used in integer mode:

- Only Underrange and Overrange conditions are reported by the module.
- Alarming and Calibration Fault activities are not available, although the Calibration Fault bit in the Module Fault word will activate if a channel is not properly calibrated.
- There is only 1 Channel Status word for all 6 channels.

When the Calibration Fault bit (bit 7) is set in any of the words, the Calibration Fault bit (bit 9) is set in the Module Fault word. Table 6.20 lists the conditions that set each of the words.

**Table 6.20**

| Tag (Status word): | Bit: | Event that sets this tag: |
|---|---|---|
| ChxUnderrange | Odd-numbered bits from bit 15 to bit 5 (e.g. bit 15 represents channel 0).<br><br>For a full listing of the channels these bits represent, see Figure 6.13 on page 6-26. | The underrange bit is set when the input signal at the channel is less than or equal to the minimum detectable signal.<br><br>For more information on the minimum detectable signal for each module, see Table 6.6 on page 6-5. This bit also sets the appropriate bit in the Channel Fault word. |
| ChxOverrange | Even-numbered bits from bit 14 to bit 4 (e.g. bit 14 represents channel 0).<br><br>For a full listing of the channels these bits represent, see Figure 6.13 on page 6-26. | The overrange bit is set when the input signal at the channel is greater than or equal to the maximum detectable signal.<br><br>For more information on the maximum detectable signal for each module, see Table 6.6 on page 6-5. This bit also sets the appropriate bit in the Channel Fault word. |

## Chapter Summary and What's Next

In this chapter you read about features specific to the Temperature Measuring Analog Modules (1756-IR6I, 1756-IT6I & 1756-IT6I2).

Chapter 7 describes features specific to the Non-Isolated Analog Output Modules (1756-OF4 & 1756-OF8).

# Non-Isolated Analog Output Modules (1756-OF4 & 1756-OF8)

## What This Chapter Contains

This chapter describes features specific to ControlLogix non-isolated analog output modules.


| For information about: | See page: |
|---|---|
| Choosing a Data Format | 7-2 |
| Features Specific to Analog Output Modules | 7-2 |
| Using Module Block and Output Circuit Diagrams | 7-6 |
| Wiring the 1756-OF4 Module | 7-9 |
| Wiring the 1756-OF8 Module | 7-10 |
| 1756-OF4 and 1756-OF8 Module Fault and Status Reporting | 7-11 |


The non-isolated analog output modules also support features described in Chapter 3. Table 7.1 lists those additional features.

**Table 7.1 Additional Features Supported by the Non-Isolated Analog Output Modules**

| Feature: | Page of description: |
|---|---|
| Removal and Insertion Under Power (RIUP) | 3-2 |
| Module Fault Reporting | 3-3 |
| Fully Software Configurable | 3-3 |
| Electronic Keying | 3-4 |
| Access to System Clock for Timestamping Functions | 3-6 |
| Rolling Timestamp | 3-6 |
| Producer/Consumer Model | 3-6 |
| Status Indicator Information | 3-7 |
| Full Class I Division 2 Compliance | 3-7 |
| UL, CSA, FM, CE, C-Tick, EEx, TUV Agency Certification | 3-7 |
| Field Calibration | 3-8 |
| Sensor Offset | 3-8 |
| Latching of Alarms | 3-8 |

## Choosing a Data Format

Data format defines the format of channel data sent from the controller to the module, defines the format of the "data echo" that the module produces, and determines the features that are available to your application. You choose a data format when you choose a Communications Format. For more information on Communications Format, see page 10-6.

You can choose one of the two following data formats:

- Integer mode
- Floating point mode

Table 7.2 lists the features that are available in each format.

**Table 7.2 Features Available in Each Data Format**

| Data format: | Features available: | Features not available: |
|---|---|---|
| Integer mode | Ramp to program value | Clamping |
| | Ramp to fault value | Ramp in Run mode |
| | Hold for initialization | Rate and Limit alarms |
| | Hold Last State or User Value in fault or program mode | Scaling |
| Floating point mode | All features | N/A |

## Features Specific to Analog Output Modules

Table 7.3 lists features that are specific to the non-isolated analog output modules. The features are described later in this section.

**Table 7.3**

| Feature: | Page of description: |
|---|---|
| Ramping/Rate Limiting | 7-3 |
| Hold for Initialization | 7-4 |
| Open Wire Detection | 7-4 |
| Clamping/Limiting | 7-5 |
| Clamp/Limit Alarms | 7-5 |
| Data Echo | 7-6 |

## Ramping/Rate Limiting

Ramping limits the speed at which an analog output signal can change. This prevents fast transitions in the output from damaging the devices that an output module controls. Ramping is also known as **rate limiting**.

Table 7.4 describes the types of ramping that are possible:

**Table 7.4**

| Ramping type: | Description: |
|---|---|
| Run mode ramping | This type of ramping occurs when the module is in Run mode and begins operation at the configured maximum ramp rate when the module receives a new output level.<br><br>**IMPORTANT**: This is only available in floating point mode. |
| Ramp to program mode | This type of ramping occurs when the present output value changes to the Program Value after a Program Command is received from the controller. |
| Ramp to fault mode | This type of ramping occurs when the present output value changes to the Fault Value after a communications fault occurs. |

The maximum rate of change in outputs is expressed in engineering units per second and called the **maximum ramp rate**. To see how to enable Run mode ramping and set the maximum ramp rate, see page 10-13.

## Hold for Initialization

Hold for Initialization causes outputs to hold present state until the value commanded by the controller matches the value at the output screw terminal within 0.1% of full scale, providing a bumpless transfer.

If Hold for Initialization is selected, outputs hold if any of the three conditions occur:

- Initial connection is established after power-up
- A new connection is established after a communications fault occurs
- There is a transition to Run mode from Program state

The InHold bit for a channel indicates that the channel is holding. To see how to enable the Hold for Initialization bit, see page 10-12.

## Open Wire Detection

This feature detects when current flow is not present at any channel. The 1756-OF4 and 1756-OF8 modules must be configured for 0-20mA operation to use this feature. At least 0.1mA of current must be flowing from the output for detection to occur.

When an open wire condition occurs at any channel, a status bit is set for that channel. For more information on the use of status bits, see page 7-11.

## Clamping/Limiting

Clamping limits the output from the analog module to remain within a range configured by the controller, even when the controller commands an output outside that range. This safety feature sets a high clamp and a low clamp.

Once clamps are determined for a module, any data received from the controller that exceeds those clamps sets an appropriate limit alarm and transitions the output to that limit but not beyond the requested value.

For example, an application may set the high clamp on a module for 8V and the low clamp for -8V. If a controller sends a value corresponding to 9V to the module, the module will only apply 8V to its screw terminals.

Clamping alarms can be disabled or latched on a per channel basis.

**IMPORTANT** Clamping is only available in floating point mode.

To see how to set the clamping limits, see page 10-13.

## Clamp/Limit Alarms

This function works directly with clamping. When a module receives a data value from the controller that exceeds clamping limits, it applies signal values to the clamping limit but also sends a status bit to the controller notifying it that the value sent exceeds the clamping limits.

Using the example above, if a module has clamping limits of 8V and -8V but then receives data to apply 9V, only 8V is applied to the screw terminals and the module sends a status bit back to the controller informing it that the 9V value exceeds the module's clamping limits.

**IMPORTANT** Limit alarms are only available in floating point mode.

To see how to enable all alarms, see page 10-13.

## Data Echo

Data Echo automatically multicasts channel data values which match the analog value that was sent to the module's screw terminals at that time.

Fault and status data is also sent.This data is sent in the format (floating point or integer) selected at the Requested Packet Interval (RPI).

# Using Module Block and Output Circuit Diagrams

This section shows the 1756-OF4 and 1756-OF8 modules' block diagrams and output circuit diagrams.

## Module Block Diagram

**Figure 7.1 1756-OF4 Module Block Diagram**

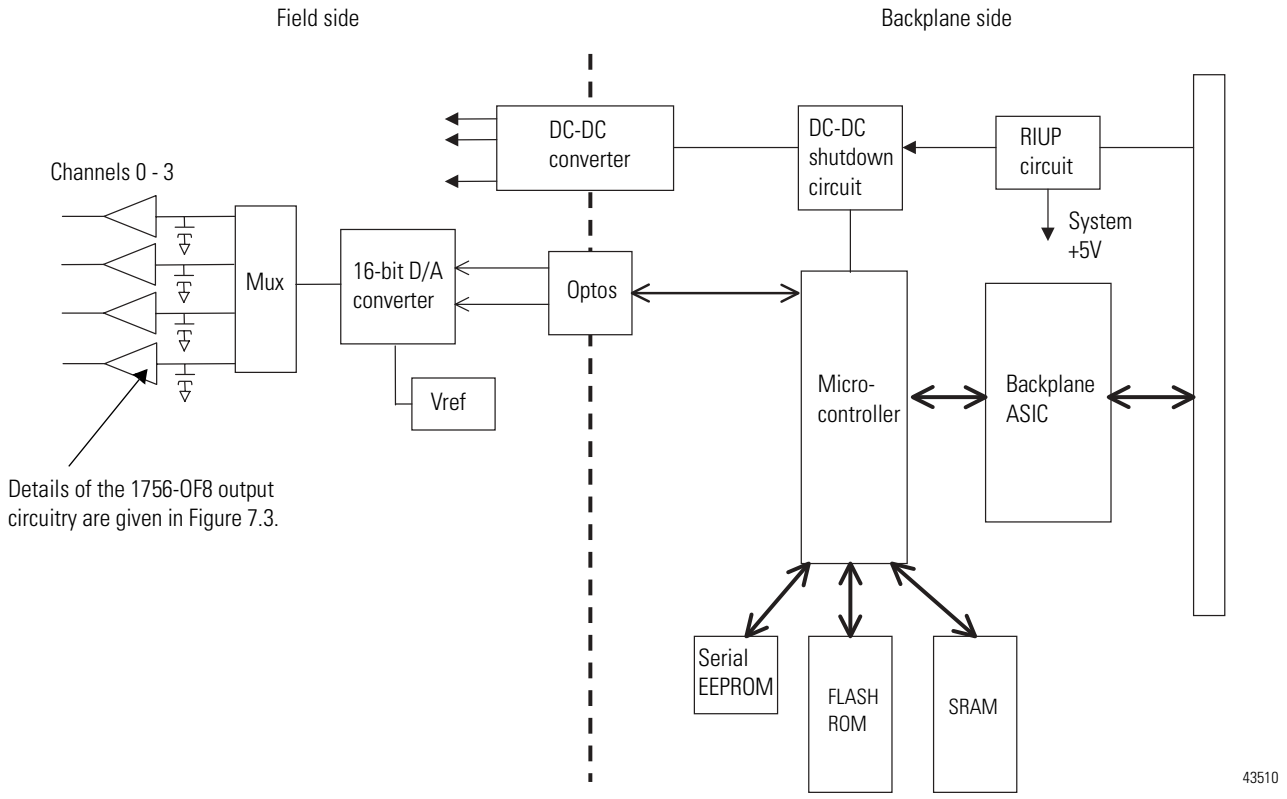
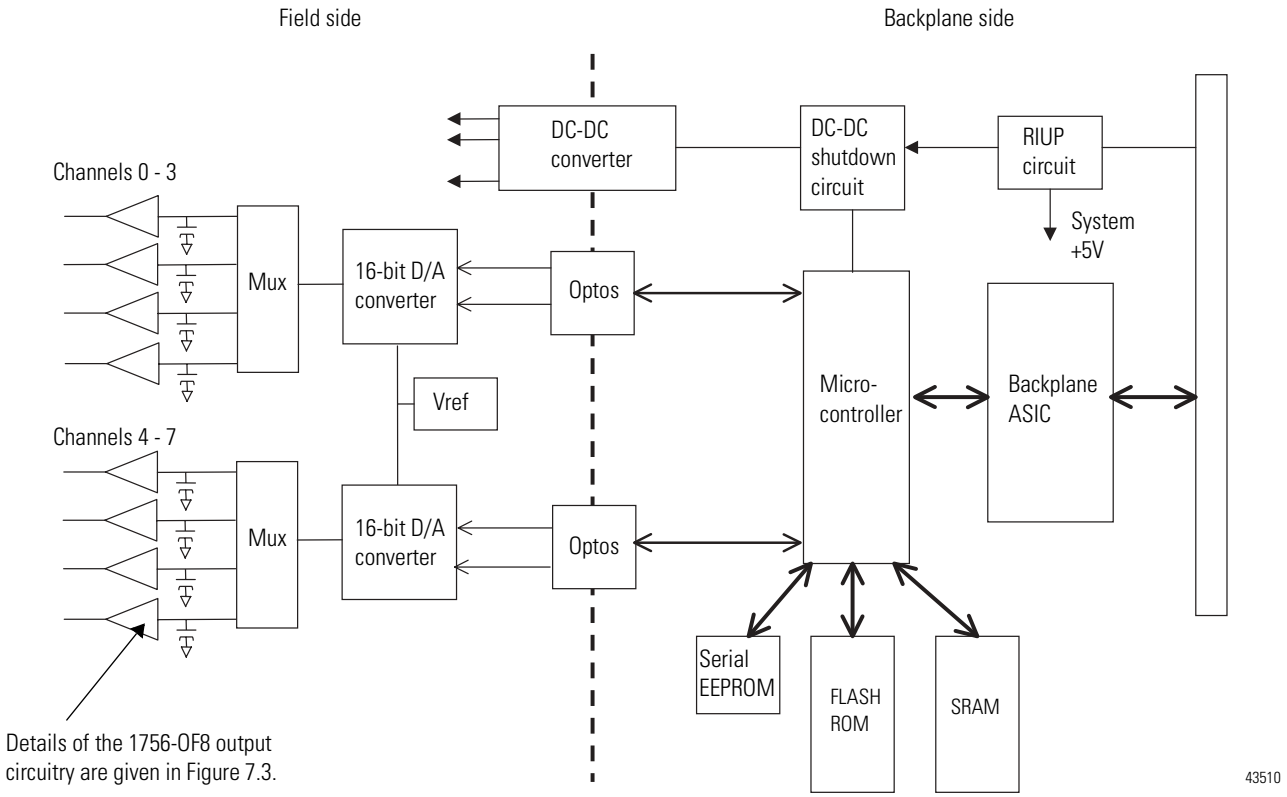
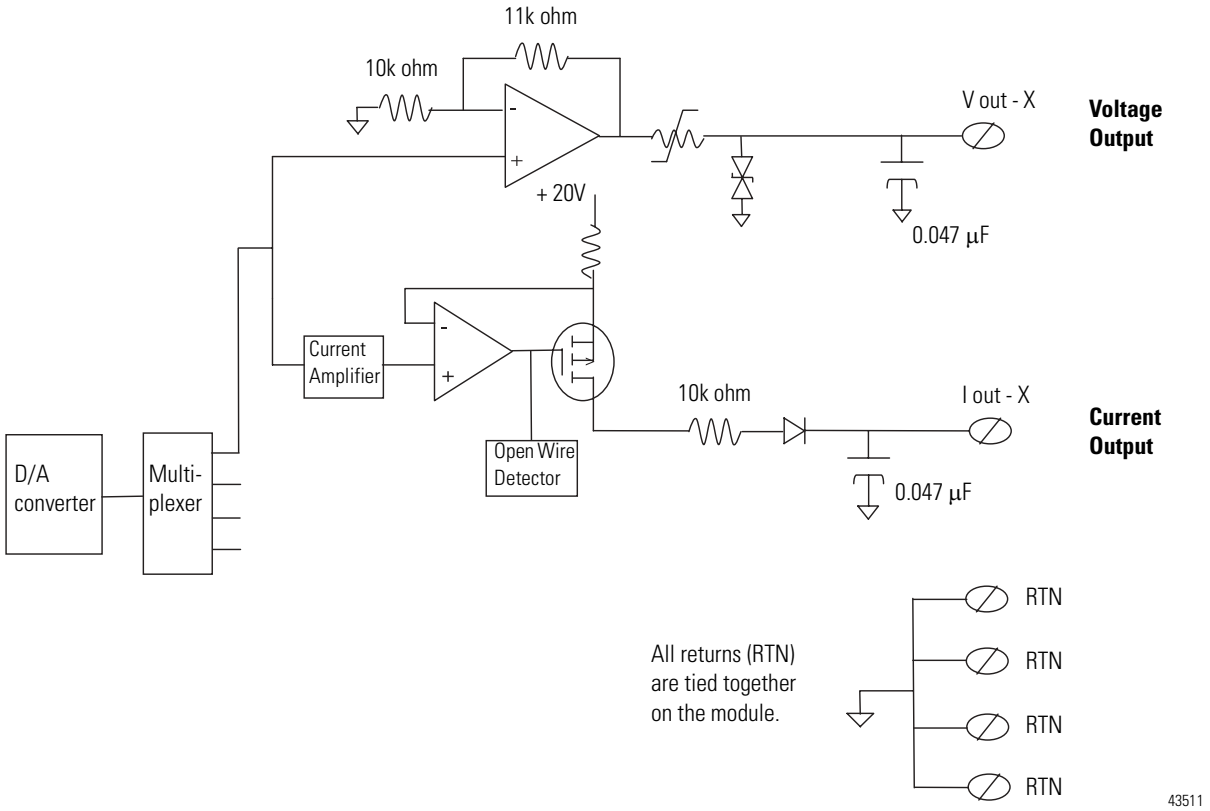


**Figure 7.2 1756-OF8 Module Block Diagram**



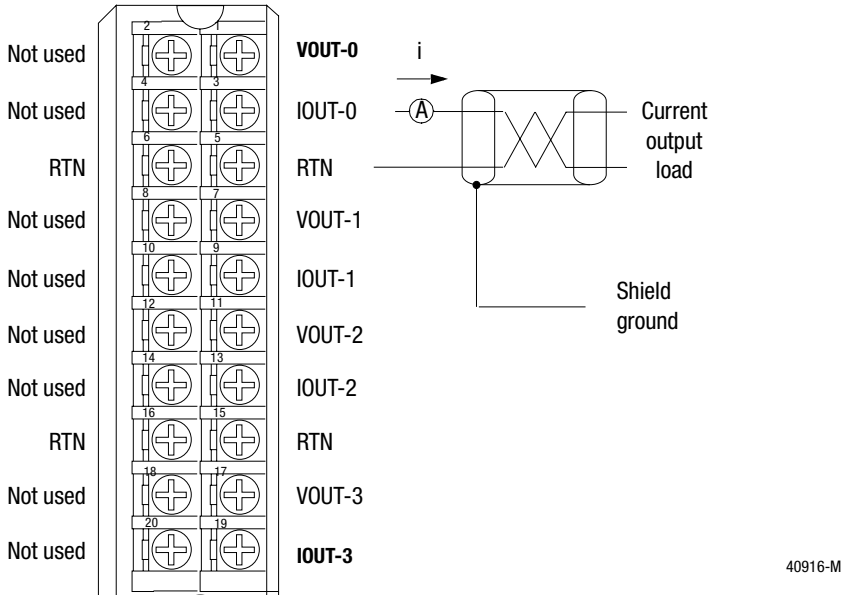
# Field Side Circuit Diagrams

**Figure 7.3 1756-OF4 and 1756-OF8 Output Circuit**



# Wiring the 1756-OF4 Module

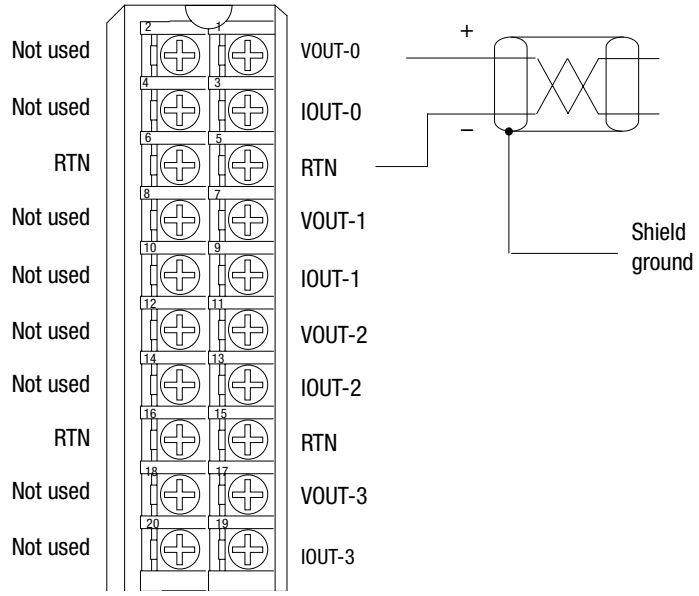
**Figure 7.4 1756-OF4 Current wiring example**




**NOTES**:

1. Place additional loop devices (e.g. strip chart recorders, etc.) at the A location noted above.
2. Do not connect more than 2 wires to any single terminal.
3. All terminals marked RTN are connected internally.

**Figure 7.5 1756-OF4 Voltage wiring example**

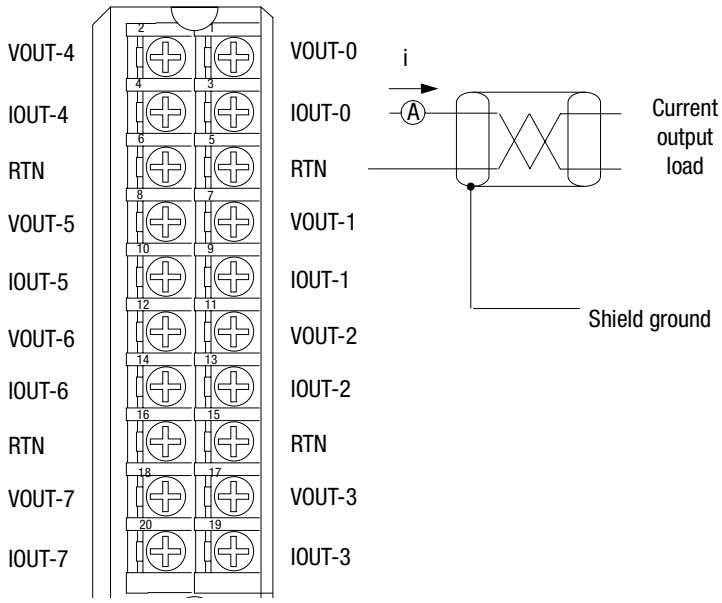



**NOTES**:

1. Do not connect more than 2 wires to any single terminal.
2. All terminals marked RTN are connected internally.

# Wiring the 1756-OF8 Module

**Figure 7.6 1756-OF8 Current wiring example**

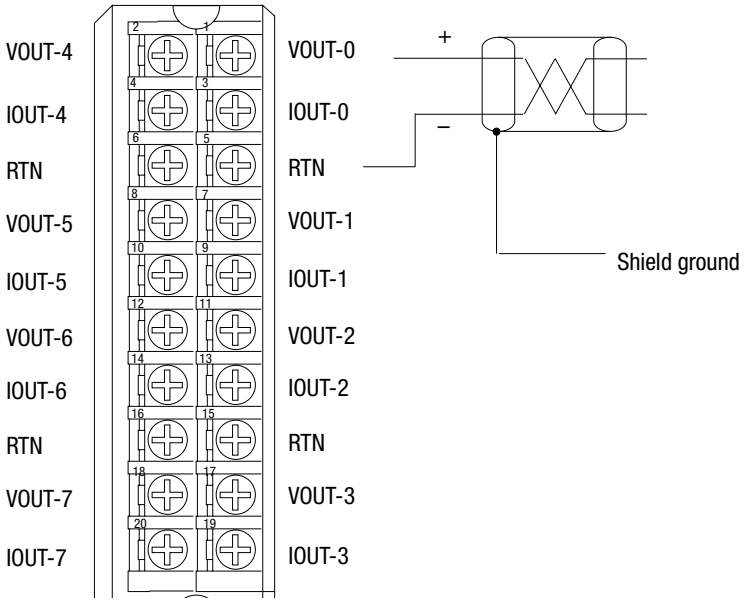



**NOTES**:

1. Place additional loop devices (e.g. strip chart recorders, etc.) at the A location noted above.
2. Do not connect more than 2 wires to any single terminal.
3. All terminals marked RTN are connected internally.

40916-M

**Figure 7.7 1756-OF8 Voltage wiring example**




**NOTES**:

1. Do not connect more than 2 wires to any single terminal.
2. All terminals marked RTN are connected internally.

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## 1756-OF4 and 1756-OF8 Module Fault and Status Reporting

The 1756-OF4 and 1756-OF8 modules multicast status/fault data to the owner/listening controller with their channel data. The fault data is arranged in such a manner as to allow the user to choose the level of granularity he desires for examining fault conditions.

Three levels of tags work together to provide increasing degree of detail as to the specific cause of faults on the module.

Table 7.5 lists tags that can be examined in ladder logic to indicate when a fault has occurred:

**Table 7.5**

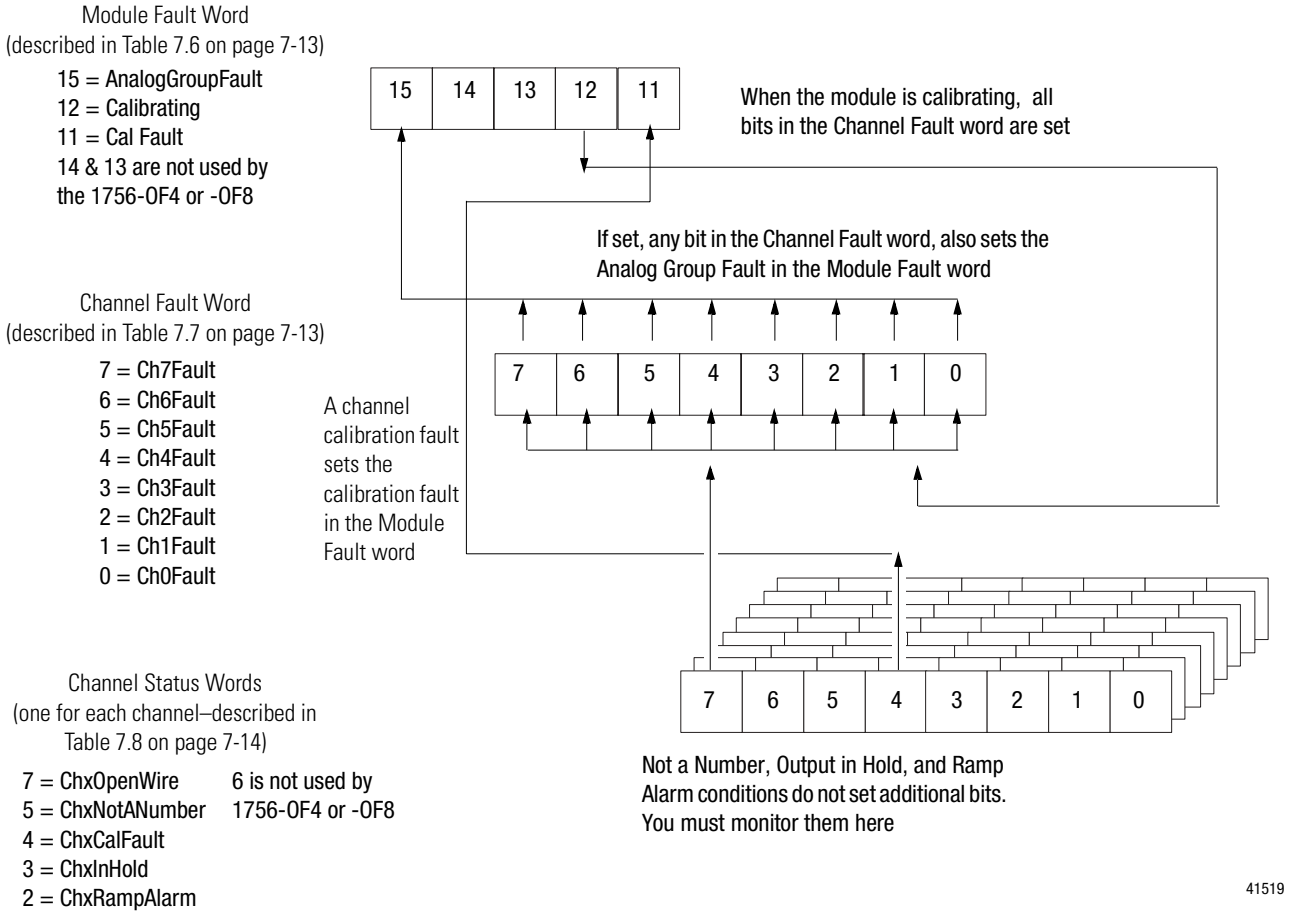
| Tag: | Description: |
|---|---|
| Module Fault Word | This word provides fault summary reporting. Its tag name is ModuleFaults. |
| Channel Fault Word | This word provides underrange, overrange and communications fault reporting. Its tag name is ChannelFaults. |
| Channel Status Words | This word provides individual channel underrange and overrange fault reporting for process alarms, rate alarms and calibration faults. Its tag name is ChxStatus. |

**IMPORTANT** Differences exist between floating point and integer modes as they relate to module fault reporting. These differences are explained in the following two sections.

# 1756-OF4 and 1756-OF8 Fault Reporting in Floating Point Mode

Figure 7.8 offers an overview of the fault reporting process in floating point mode.

**Figure 7.8**


Module Fault Word
(described in Table 7.6 on page 7-13)
15 = AnalogGroupFault
12 = Calibrating
11 = Cal Fault
14 & 13 are not used by
the 1756-OF4 or -OF8
15 14 13 12 11
When the module is calibrating, all
bits in the Channel Fault word are set
If set, any bit in the Channel Fault word, also sets the
Analog Group Fault in the Module Fault word
Channel Fault Word
(described in Table 7.7 on page 7-13)
7 = Ch7Fault
6 = Ch6Fault
5 = Ch5Fault
4 = Ch4Fault
3 = Ch3Fault
2 = Ch2Fault
1 = Ch1Fault
0 = Ch0Fault
7 6 5 4 3 2 1 0
A channel
calibration fault
sets the
calibration fault
in the Module
Fault word
Channel Status Words
(one for each channel–described in
Table 7.8 on page 7-14)
7 = ChxOpenWire
6 is not used by
1756-OF4 or -OF8
5 = ChxNotANumber
4 = ChxCalFault
3 = ChxInHold
2 = ChxRampAlarm
1 = ChxLLimitAlarm
0 = ChxHLimitAlarm
7 6 5 4 3 2 1 0
Not a Number, Output in Hold, and Ramp
Alarm conditions do not set additional bits.
You must monitor them here
41519

**IMPORTANT**: 1756-OF4 uses 4 Channel Status Words. 1756-OF8 uses 8 Channel Status words. This graphic shows 8 words.

## Module Fault Word Bits – Floating Point Mode

Bits in this word provide the highest level of fault detection. A nonzero condition in this word reveals that a fault exists on the module. You can examine further down to isolate the fault.

Table 7.6 lists tags that are found in the Module Fault Word:

**Table 7.6**

| Tag: | Description: |
|---|---|
| Analog Group Fault | This bit is set when any bits in the Channel Fault word are set. Its tag name is AnalogGroupFault. |
| Calibrating | This bit is set when any channel is being calibrated. When this bit is set, all bits in the Channel Fault word are set. Its tag name is Calibrating. |
| Calibration Fault | This bit is set when any of the individual Channel Calibration Fault bits are set. Its tag name is CalibrationFault. |

## Channel Fault Word Bits – Floating Point Mode

During normal module operation, Channel Fault word bits are set if any of the respective channels has a High or Low Limit Alarm or an Open Wire condition (0-20mA configuration only). When using the Channel Fault Word, the 1756-OF4 module uses bits 0-3, and the 1756-OF8 uses bits 0-7. Checking this word for a nonzero condition is a quick way to check for these conditions on a channel.

Table 7.7 lists the conditions that set **all** Channel Fault word bits:

**Table 7.7**

| This condition sets all Channel Fault word bits: | And causes the module to display the following in the Channel Fault word bits: |
|---|---|
| A channel is being calibrated | "000F" for all bits on the 1756-OF4 module<br>"00FF" for all bits on the 1756-OF8 module |
| A communications fault occurred between the module and its owner-controller | "FFFF" for all bits on either module |

Your logic should monitor the Channel Fault bit for a particular output, if you either:

- enable output clamping

or

- are checking for a open wire condition (0-20mA configuration only).

## Channel Status Words Bits – Floating Point Mode

Any of the Channel Status words (4 words for 1756-OF4 and 8 words for 1756-OF8), one for each channel, will display a nonzero condition if that particular channel has faulted for the conditions listed below. Some of these bits set bits in other Fault words.

When the High or Low Limit Alarm bits (bits 1 & 0) in any of the words are set, the appropriate bit is set in the Channel Fault word.

When the Calibration Fault bit (bit 4) is set in any of the words, the Calibration Fault bit (bit 11) is set in the Module Fault word. Table 7.8 lists the conditions that set each of the word bits.

**Table 7.8**

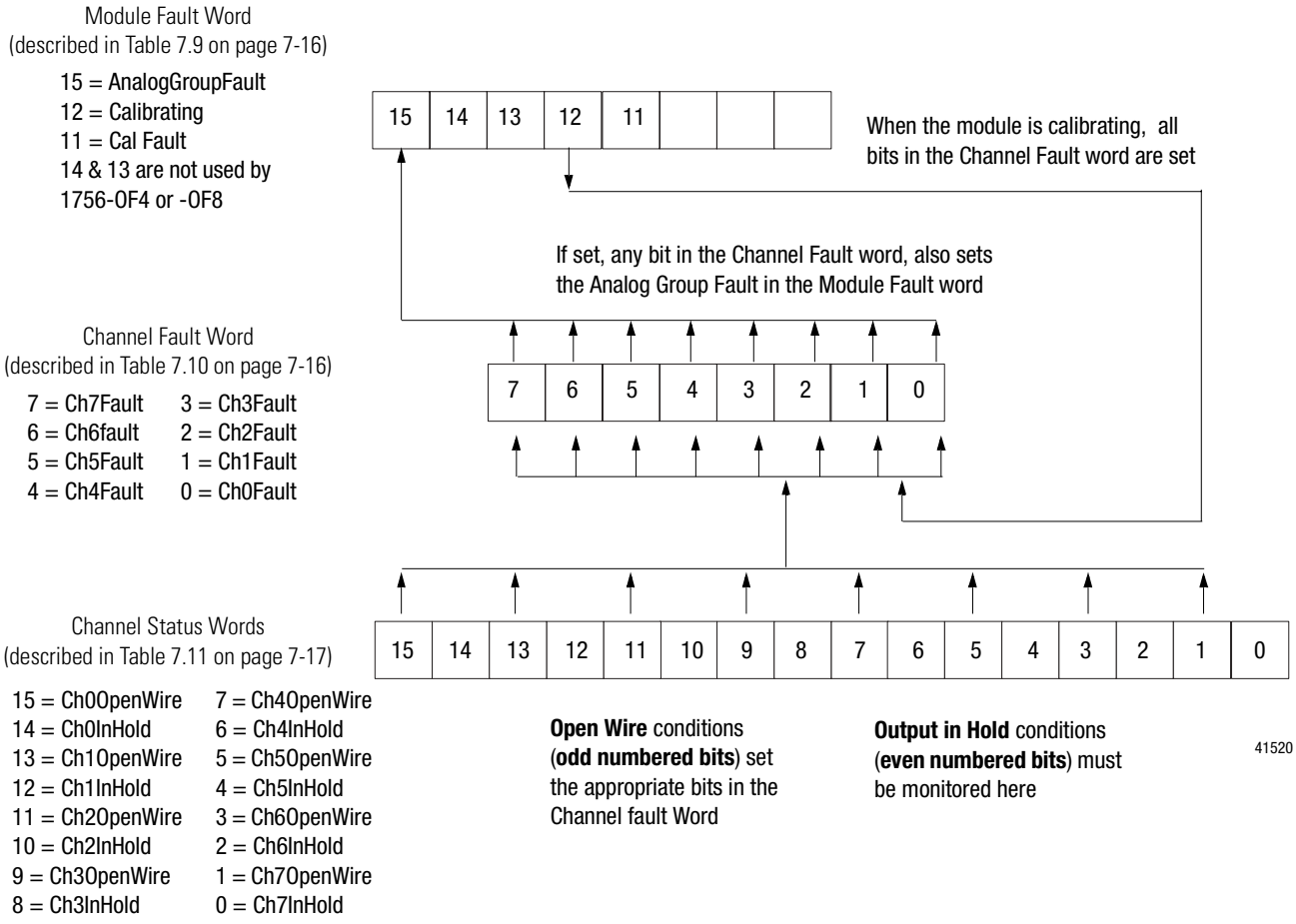
| Tag (Status word): | Bit: | Event that sets this tag: |
|---|---|---|
| ChxOpenWire | Bit 7 | This bit is set only if the configured Output Range is 0-20mA, and the circuit becomes open due to a wire falling or being cut when the output being driven is above 0.1mA. The bit will remain set until correct wiring is restored. |
| ChxNotaNumber | Bit 5 | This bit is set when the output value received from the controller is NotANumber (the IEEE NAN value). The output channel will hold its last state. |
| ChxCalFault | Bit 4 | This bit is set when an error occurred when calibrating This bit also sets the appropriate bit in the Channel Fault word. |
| ChxInHold | Blt 3 | This bit is set when the output channel is currently holding. The bit resets when the requested Run mode output value is within 0.1% of full-scale of the current echo value. |
| ChxRampAlarm | Bit 2 | This bit is set when the output channel's requested rate of change would exceed the configured maximum ramp rate requested parameter. It remains set until the output reaches its target value and ramping stops. If the bit is latched, it will remain set until it is unlatched. |
| ChxLLimitAlarm | Bit 1 | This bit is set when the requested output value is beneath the configured low limit value. It remains set until the requested output is above the low limit. If the bit is latched, it will remain set until it is unlatched. |
| ChxHLimitAlarm | Bit 0 | This bit is set when the requested output value is above the configured high limit value. It remains set until the requested output is below the high limit. If the bit is latched, it will remain set until it is unlatched. |

**IMPORTANT** Notice that the 1756-OF4 and 1756-OF8 modules do not use **bit 6**.

# 1756-OF4 and 1756-OF8 Fault Reporting in Integer Mode

The following graphic provides an overview of the fault reporting process in integer mode.

**Figure 7.9**


Module Fault Word
(described in Table 7.9 on page 7-16)
15 = AnalogGroupFault
12 = Calibrating
11 = Cal Fault
14 & 13 are not used by
1756-OF4 or -OF8
15 14 13 12 11
When the module is calibrating, all bits in the Channel Fault word are set
If set, any bit in the Channel Fault word, also sets the Analog Group Fault in the Module Fault word
Channel Fault Word
(described in Table 7.10 on page 7-16)
7 = Ch7Fault
6 = Ch6fault
5 = Ch5Fault
4 = Ch4Fault
3 = Ch3Fault
2 = Ch2Fault
1 = Ch1Fault
0 = Ch0Fault
7 6 5 4 3 2 1 0
Channel Status Words
(described in Table 7.11 on page 7-17)
15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
15 = Ch0OpenWire
14 = Ch0InHold
13 = Ch1OpenWire
12 = Ch1InHold
11 = Ch2OpenWire
10 = Ch2InHold
9 = Ch3OpenWire
8 = Ch3InHold
7 = Ch4OpenWire
6 = Ch4InHold
5 = Ch5OpenWire
4 = Ch5InHold
3 = Ch6OpenWire
2 = Ch6InHold
1 = Ch7OpenWire
0 = Ch7InHold
**Open Wire** conditions (**odd numbered bits**) set the appropriate bits in the Channel fault Word
**Output in Hold** conditions (**even numbered bits**) must be monitored here
41520

**IMPORTANT**: Bits 0-7 not used on 1756-OF4

## Module Fault Word Bits – Integer Mode

In integer mode, Module Fault word bits (bits 15-11) operate exactly as described in floating point mode. Table 7.9 lists tags that are found in the Module Fault Word:

**Table 7.9**

| Tag: | Description: |
|---|---|
| Analog Group Fault | This bit is set when any bits in the Channel Fault word are set. Its tag name is AnalogGroupFault. |
| Calibrating | This bit is set when any channel is being calibrated. When this bit is set, all bits in the Channel Fault word are set. Its tag name is Calibrating. |
| Calibration Fault | This bit is set when any of the individual Channel Calibration Fault bits are set. Its tag name is CalibrationFault. |

## Channel Fault Word Bits – Integer Mode

In integer mode, Channel Fault word bits (bits 7-0) operate exactly as described in floating point mode for calibration and communications faults. During normal operation, these bits are only set for an open wire condition. Table 7.10 lists the conditions that set **all** Channel Fault word bits:

**Table 7.10**

| This condition sets all Channel Fault word bits: | And causes the module to display the following in the Channel Fault word bits: |
|---|---|
| A channel is being calibrated | "000F" for all bits on the 1756-OF4 module<br>"00FF" for all bits on the 1756-OF8 module |
| A communications fault occurred between the module and its owner-controller | "FFFF" for all bits on either module |

Your logic should monitor the Channel Fault bit for a particular output, if you either:

- enable output clamping

  or

- are checking for a open wire condition (0-20mA configuration only).

### Channel Status Word Bits – Integer Mode

The Channel Status word has the following differences when used in integer mode:

- Only the Output in Hold and Open Wire conditions are reported by the module.
- Calibration Fault reporting is not available in this word, although the Calibration Fault bit in the Module Fault word will still activate when that condition exists on any channel.
- There is only 1 Channel Status word for all 4 channels on 1756-OF4 and all 8 channels on 1756-OF8.

Table 7.11 lists the conditions that set each of the Status Word bits.

**Table 7.11**

| Tag (Status word): | Bit: | Event that sets this tag: |
|---|---|---|
| ChxOpenWire | Odd-numbered bits from bit 15 to bit 1 (e.g. bit 15 represents channel 0).<br><br>For a full listing of the channels these bits represent, see Figure 7.9 on page 7-15. | The Open Wire bit is set only if the configured Output Range is 0-20mA, and the circuit becomes open due to a wire falling or being cut when the output being driven is above 0.1mA. The bit will remain set until correct wiring is restored. |
| ChxInHold | Even-numbered bits from bit 14 to bit 0 (e.g. bit 14 represents channel 0).<br><br>For a full listing of the channels these bits represent, see Figure 7.9 on page 7-15. | The Output In Hold bit is set when the output channel is currently holding. The bit resets when the requested Run mode output value is within 0.1% of full-scale of the current echo value. |

## Chapter Summary and What's Next

In this chapter you read about Non-Isolated Analog Output Modules (1756-OF4 & 1756-OF8).

Chapter 8 describes the Isolated Analog Output Modules (1756-OF6CI & 1756-OF6VI).

## Notes:

# Isolated Analog Output Modules (1756-OF6CI & 1756-OF6VI)

## What This Chapter Contains

This chapter describes features specific to ControlLogix non-isolated analog output modules.


| For information about: | See page: |
|---|---|
| Choosing a Data Format | 8-2 |
| Features Specific to Analog Output Modules | 8-2 |
| Using Module Block and Output Circuit Diagrams | 8-5 |
| Wiring the 1756-OF6CI Module | 8-9 |
| Wiring the 1756-OF6VI Module | 8-10 |
| 1756-OF6CI and 1756-OF6VI Module Fault and Status Reporting | 8-11 |


The non-isolated analog output modules also support features described in Chapter 3. Table 8.1 lists those additional features.

**Table 8.1 Additional Features Supported by the Isolated Analog Output Modules**

| Feature: | Page of description: |
|---|---|
| Removal and Insertion Under Power (RIUP) | 3-2 |
| Module Fault Reporting | 3-3 |
| Fully Software Configurable | 3-3 |
| Electronic Keying | 3-4 |
| Access to System Clock for Timestamping Functions | 3-6 |
| Rolling Timestamp | 3-6 |
| Producer/Consumer Model | 3-6 |
| Status Indicator Information | 3-7 |
| Full Class I Division 2 Compliance | 3-7 |
| UL, CSA, FM, CE, C-Tick, EEx, TUV Agency Certification | 3-7 |
| Field Calibration | 3-8 |
| Sensor Offset | 3-8 |
| Latching of Alarms | 3-8 |

## Choosing a Data Format

Data format defines the format of channel data sent from the controller to the module, defines the format of the "data echo" that the module produces, and determines the features that are available to your application. You choose a data format when you choose a Communications Format. For more information on Communications Format, see page 10-6.

You can choose one of the two following data formats:

- Integer mode
- Floating point mode

Table 8.2 lists the features that are available in each format.

**Table 8.2 Features Available in Each Data Format**

| Data format: | Features available: | Features not available: |
|---|---|---|
| Integer mode | Ramp to program value | Clamping |
| | Ramp to fault value | Ramp in Run mode |
| | Hold for initialization | Rate and Limit alarms |
| | Hold Last State or User Value in fault or program mode | Scaling |
| Floating point mode | All features | N/A |

## Features Specific to Analog Output Modules

Table 8.3 lists features that are specific to the non-isolated analog output modules. The features are described later in this section.

**Table 8.3**

| Feature: | Page of description: |
|---|---|
| Ramping/Rate Limiting | 8-3 |
| Hold for Initialization | 8-3 |
| Clamping/Limiting | 8-4 |
| Clamp/Limit Alarms | 8-4 |
| Data Echo | 8-5 |

## Ramping/Rate Limiting

Ramping limits the speed at which an analog output signal can change. This prevents fast transitions in the output from damaging the devices that an output module controls. Ramping is also known as **rate limiting**.

Table 8.4 describes the types of ramping that are possible:

**Table 8.4**

| Ramping type: | Description: |
|---|---|
| Run mode ramping | This type of ramping occurs when the module is in Run mode and begins operation at the configured maximum ramp rate when the module receives a new output level.<br><br>**IMPORTANT**: This is only available in floating point mode. |
| Ramp to program mode | This type of ramping occurs when the present output value changes to the Program Value after a Program Command is received from the controller. |
| Ramp to fault mode | This type of ramping occurs when the present output value changes to the Fault Value after a communications fault occurs. |

The maximum rate of change in outputs is expressed in engineering units per second and called the **maximum ramp rate**. To see how to enable Run mode ramping and set the maximum ramp rate, see page 10-13.

## Hold for Initialization

Hold for Initialization causes outputs to hold present state until the value commanded by the controller matches the value at the output screw terminal within 0.1% of full scale, providing a bumpless transfer.

If Hold for Initialization is selected, outputs hold if any of the three conditions occur:

- Initial connection is established after power-up
- A new connection is established after a communications fault occurs
- There is a transition to Run mode from Program state

The InHold bit for a channel indicates that the channel is holding. To see how to enable the Hold for Initialization bit, see page 10-12.

## Clamping/Limiting

Clamping limits the output from the analog module to remain within a range configured by the controller, even when the controller commands an output outside that range. This safety feature sets a high clamp and a low clamp.

Once clamps are determined for a module, any data received from the controller that exceeds those clamps sets an appropriate limit alarm and transitions the output to that limit but not beyond the requested value.

For example, an application may set the high clamp on a module for 8V and the low clamp for -8V. If a controller sends a value corresponding to 9V to the module, the module will only apply 8V to its screw terminals.

Clamping alarms can be disabled or latched on a per channel basis.

**IMPORTANT** Clamping is only available in floating point mode.

To see how to set the clamping limits, see page 10-13.

## Clamp/Limit Alarms

This function works directly with clamping. When a module receives a data value from the controller that exceeds clamping limits, it applies signal values to the clamping limit but also sends a status bit to the controller notifying it that the value sent exceeds the clamping limits.

Using the example above, if a module has clamping limits of 8V and -8V but then receives data to apply 9V, only 8V is applied to the screw terminals and the module sends a status bit back to the controller informing it that the 9V value exceeds the module's clamping limits.

**IMPORTANT** Limit alarms are only available in floating point mode.

To see how to enable all alarms, see page 10-13.

## Data Echo

Data Echo automatically multicasts channel data values which match the analog value that was sent to the module's screw terminals at that time.

Fault and status data is also sent.This data is sent in the format (floating point or integer) selected at the Requested Packet Interval (RPI).

# Using Module Block and Output Circuit Diagrams

This section shows the 1756-OF6CI and 1756-OF6VI modules' block diagrams and output circuit diagrams.

## Module Block Diagram

**Figure 8.1 1756-OF6CI Module Block Diagram**

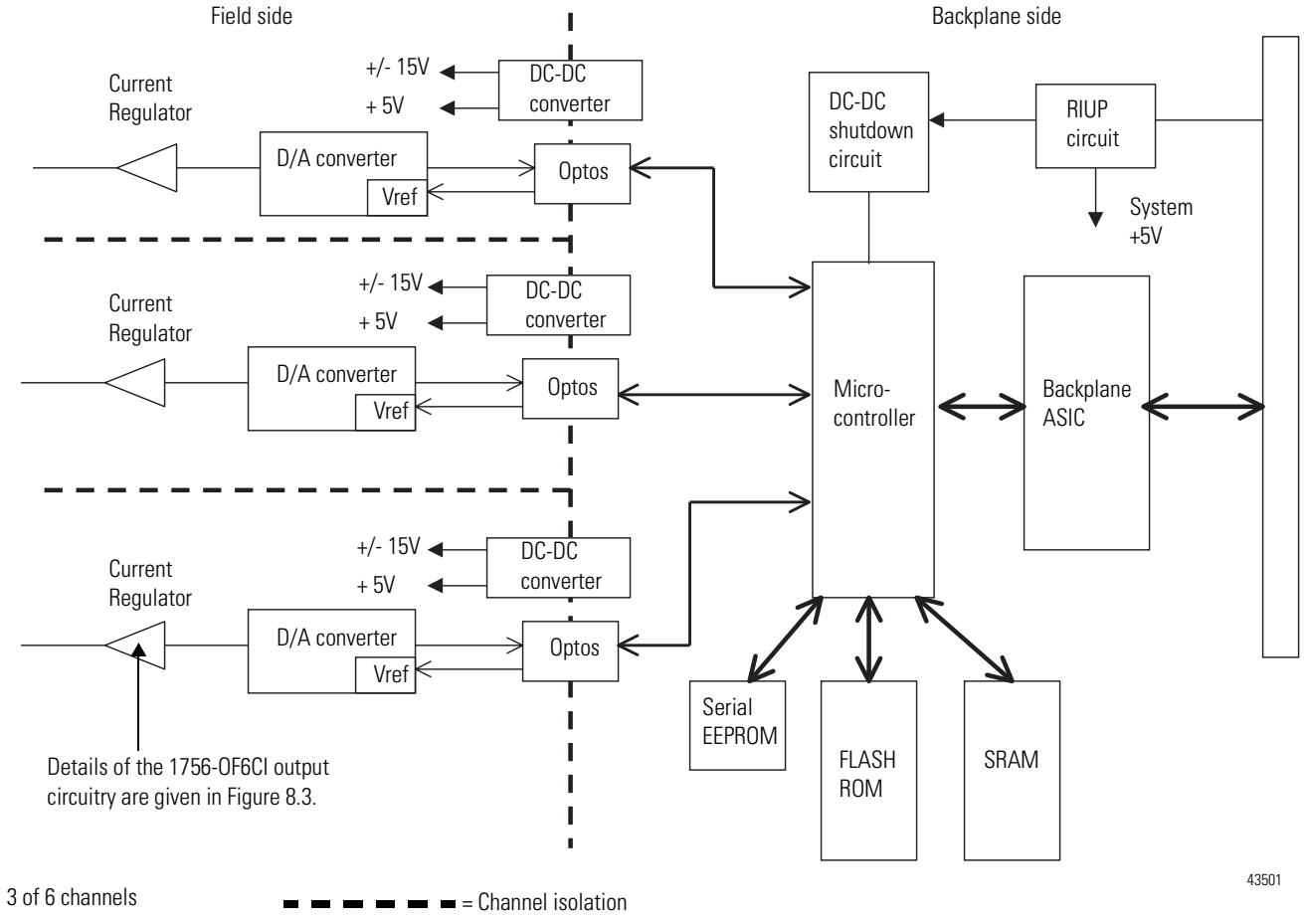
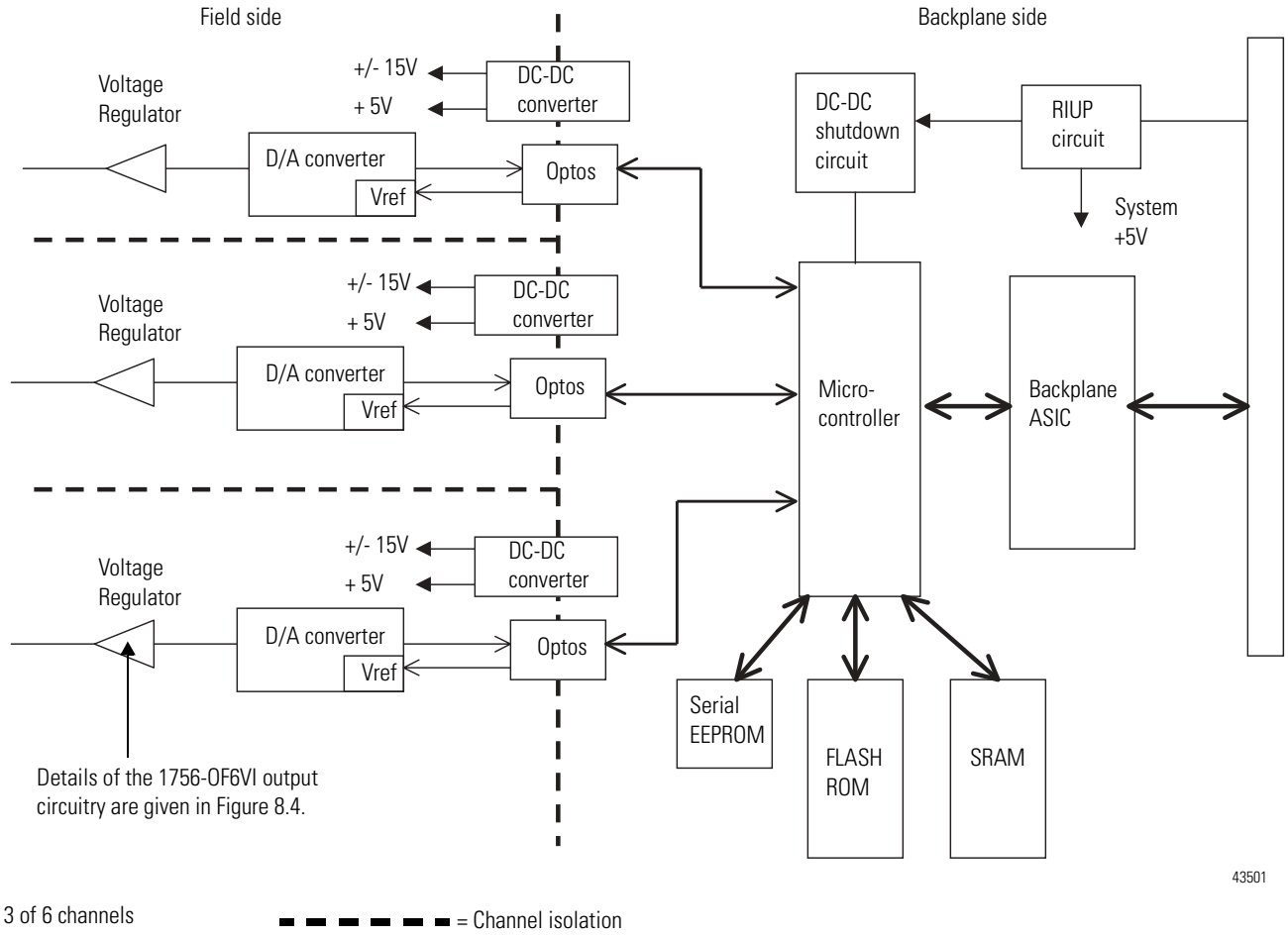
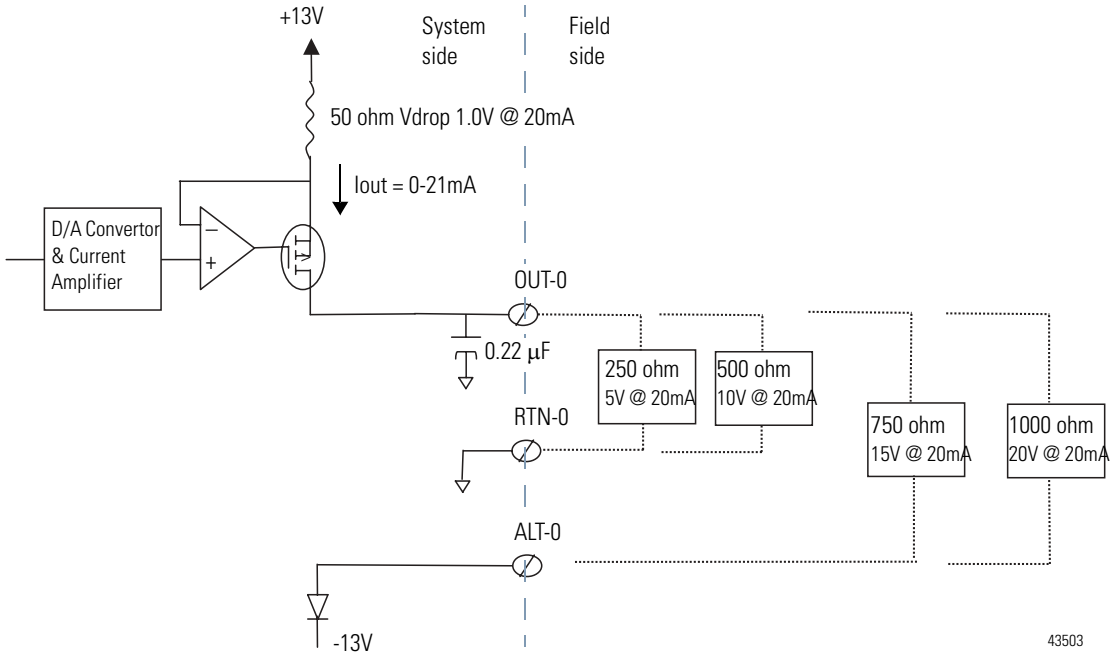


**Figure 8.2 1756-OF6VI Module Block Diagram**



## Field Side Circuit Diagrams

**Figure 8.3 1756-OF6CI Output Circuit**




## Driving Different Loads with the 1756-OF6CI

The 1756-OF6CI module's output stage provides a constant current that flows through its internal electronics and out through the external output load. Since the output current is constant, the only variable in the current loop is the voltage across the output electronics and the voltage across the load. For a given termination option, the sum of the individual voltage drops around the loop components must add up to the total available voltage (13V for OUT-x/RTN-x termination and 26V for OUT-x / ALT-x). As seen above, a larger external output load will drop a larger portion of the available loop voltage, allowing the module to drop less volts across its internal output electronics. This lower drop allows the power dissipation in the module to be lower, minimizing the thermal affect to adjacent modules in the same chassis.

For loads under 550 ohm, the module's +13V internal voltage source can supply voltage for currents up to 21mA. For loads over 550 ohms, additional compliance voltage is required. In this case, you must use the ALT terminal to provide the additional -13V source.

For any size load (i.e. 0-1000 ohms), the output channels function if terminated between OUT-x and ALT-x. To improve module reliability and product life, we recommend you:

- Terminate the output channels between the OUT-x and RTN-x terminals for loads of 0-550 ohms
- Terminate the output channels between the OUT-x and ALT-x terminals for loads of 551 -1000 ohms.

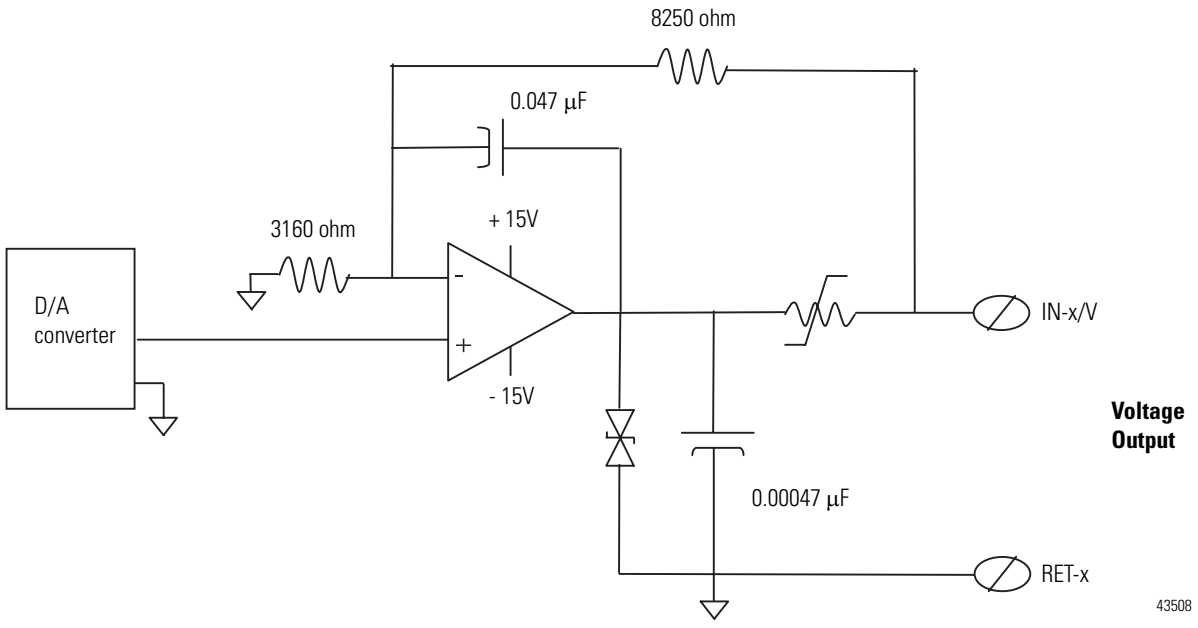
**IMPORTANT**

If you are unsure of the load, you can terminate the output channels between OUT-x and ALT-x and the module will operate but its reliability may be compromised at elevated temperatures.

For example, if you terminate the output channels between OUT-x and ALT-x and use a 250 ohm load, the module operates but the lower load results in higher operating temperatures and may affect the module's reliability over time.

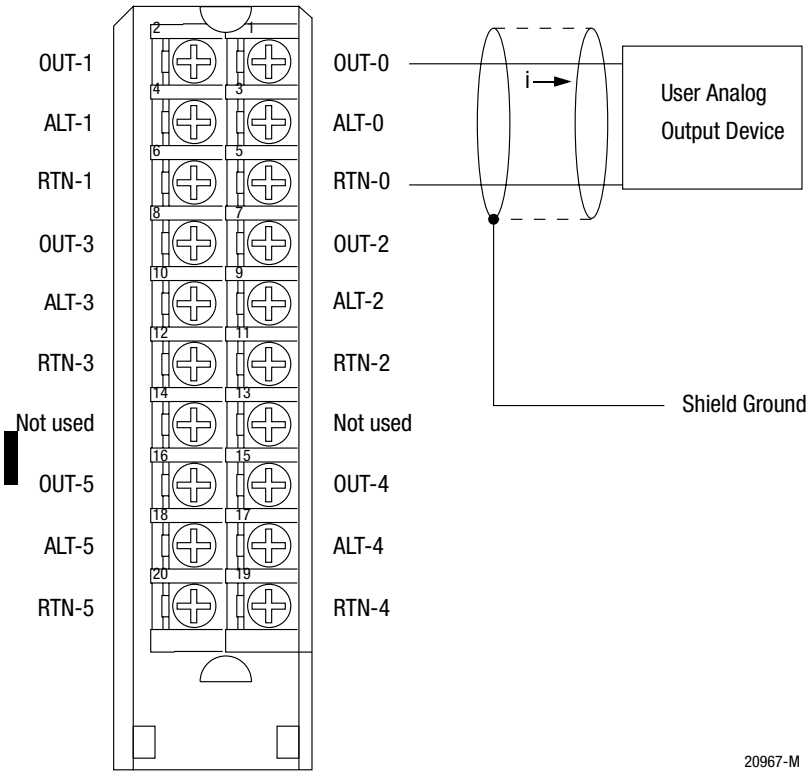
We recommend you terminate the output channels as described in the bullets above whenever possible.

**Figure 8.4 1756-OF6VI Output Circuit**



# Wiring the 1756-OF6CI Module

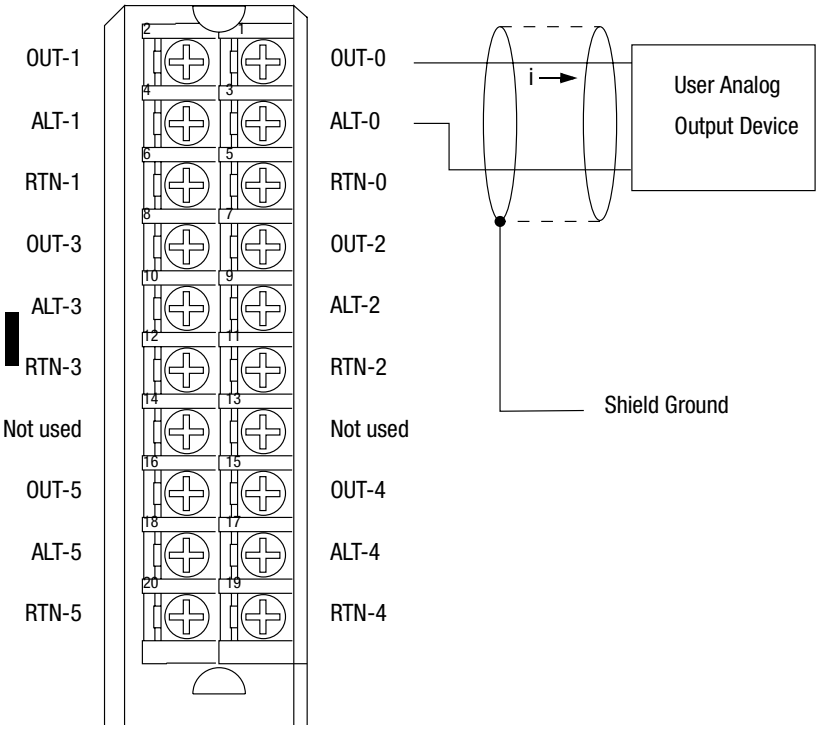
**Figure 8.5 1756-OF6CI Wiring example for Loads of 0-550Ω**




**NOTES**:

1. Place additional devices anywhere in the loop.
2. Do not connect more than 2 wires to any single terminal.

**Figure 8.6 1756-OF6CI Wiring example for Loads of 551-1000Ω**

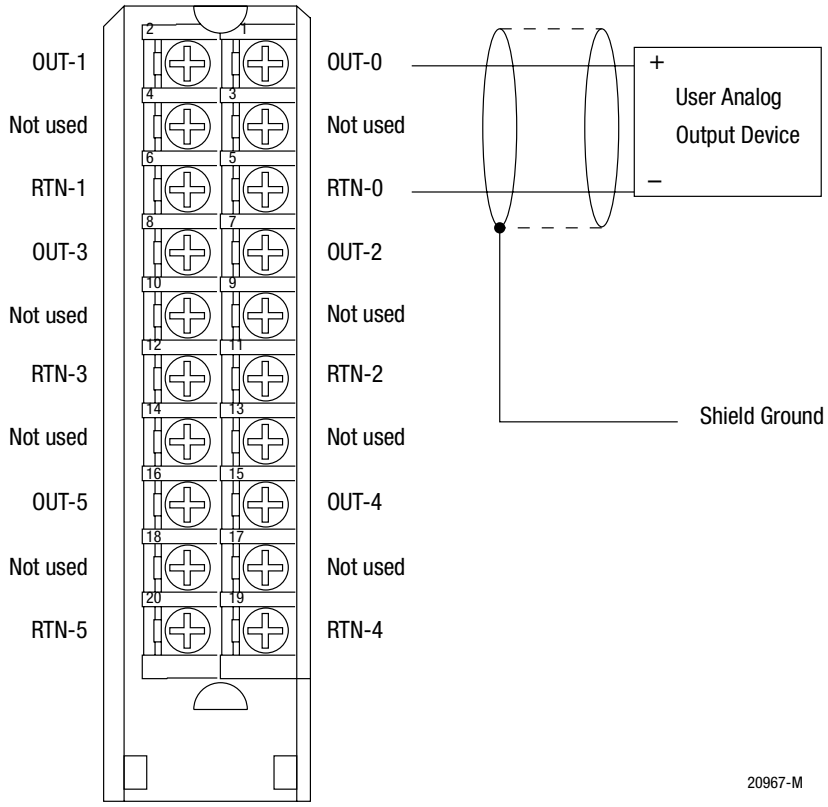



**NOTES**:

1. Place additional devices anywhere in the loop.
2. Do not connect more than 2 wires to any single terminal.

# Wiring the 1756-OF6VI Module

**Figure 8.7 1756-OF6VI Wiring example**




**NOTES**:

1. Place additional devices anywhere in the loop.
2. Do not connect more than 2 wires to any single terminal.

## 1756-OF6CI and 1756-OF6VI Module Fault and Status Reporting

The 1756-OF6CI and 1756-OF6VI modules multicast status/fault data to the owner/listening controller with their channel data. The fault data is arranged in such a manner as to allow the user to choose the level of granularity he desires for examining fault conditions.

Three levels of tags work together to provide increasing degree of detail as to the specific cause of faults on the module.

Table 8.5 lists tags that can be examined in ladder logic to indicate when a fault has occurred:

**Table 8.5**

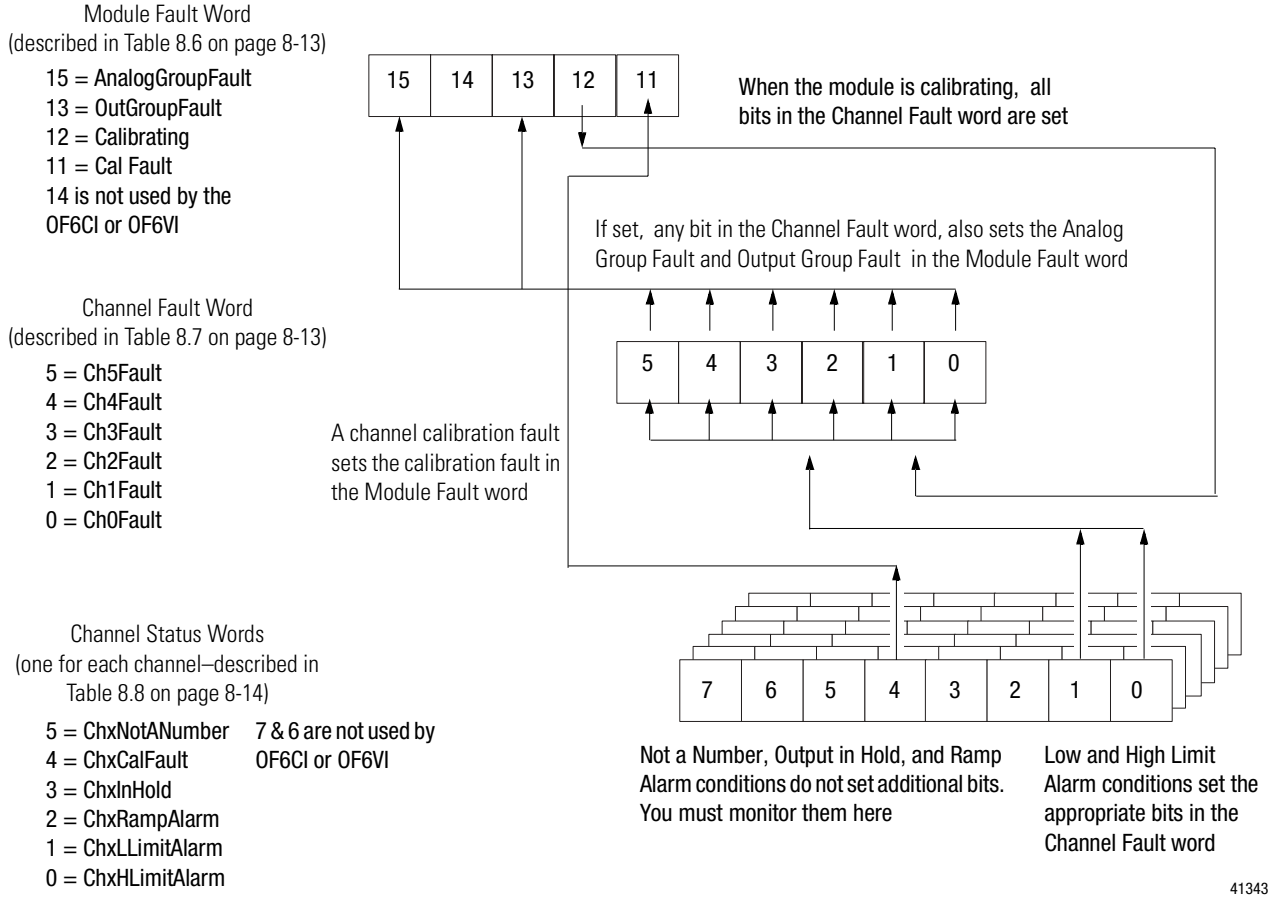
| Tag: | Description: |
|---|---|
| Module Fault Word | This word provides fault summary reporting. Its tag name is ModuleFaults. |
| Channel Fault Word | This word provides underrange, overrange and communications fault reporting. Its tag name is ChannelFaults. |
| Channel Status Words | This word provides individual channel underrange and overrange fault reporting for process alarms, rate alarms and calibration faults. Its tag name is ChxStatus. |

**IMPORTANT** Differences exist between floating point and integer modes as they relate to module fault reporting. These differences are explained in the following two sections.

## Fault Reporting in Floating Point Mode

Figure 8.8 offers an overview of the fault reporting process in floating point mode.

**Figure 8.8**


Module Fault Word
(described in Table 8.6 on page 8-13)
15 = AnalogGroupFault
13 = OutGroupFault
12 = Calibrating
11 = Cal Fault
14 is not used by the OF6CI or OF6VI
15 14 13 12 11
When the module is calibrating, all bits in the Channel Fault word are set
If set, any bit in the Channel Fault word, also sets the Analog Group Fault and Output Group Fault in the Module Fault word
Channel Fault Word
(described in Table 8.7 on page 8-13)
5 = Ch5Fault
4 = Ch4Fault
3 = Ch3Fault
2 = Ch2Fault
1 = Ch1Fault
0 = Ch0Fault
5 4 3 2 1 0
A channel calibration fault sets the calibration fault in the Module Fault word
Channel Status Words
(one for each channel–described in Table 8.8 on page 8-14)
5 = ChxNotANumber
4 = ChxCalFault
3 = ChxInHold
2 = ChxRampAlarm
1 = ChxLLimitAlarm
0 = ChxHLimitAlarm
7 & 6 are not used by OF6CI or OF6VI
7 6 5 4 3 2 1 0
Not a Number, Output in Hold, and Ramp Alarm conditions do not set additional bits. You must monitor them here
Low and High Limit Alarm conditions set the appropriate bits in the Channel Fault word
41343

## Module Fault Word Bits – Floating Point Mode

Bits in this word provide the highest level of fault detection. A nonzero condition in this word reveals that a fault exists on the module. You can examine further down to isolate the fault.

Table 8.6 lists tags that are found in the Module Fault Word:

**Table 8.6**

| Tag: | Description: |
|---|---|
| Analog Group Fault | This bit is set when any bits in the Channel Fault word are set. Its tag name is AnalogGroupFault. |
| Output Group Fault | This bit is set when any bits in the Channel Fault word are set. Its tag name is OutputGroupFault. |
| Calibrating | This bit is set when any channel is being calibrated. When this bit is set, all bits in the Channel Fault word are set. Its tag name is Calibrating. |
| Calibration Fault | This bit is set when any of the individual Channel Calibration Fault bits are set. Its tag name is CalibrationFault. |

## Channel Fault Word Bits – Floating Point Mode

During normal module operation, Channel Fault word bits are set if any of the respective channels has a High or Low Limit Alarm. Checking this word for a nonzero condition is a quick way to check for High or Low Limit Alarm condition on a channel.

Table 8.7 lists the conditions that set **all** Channel Fault word bits:

**Table 8.7**

| This condition sets all Channel Fault word bits: | And causes the module to display the following in the Channel Fault word bits: |
|---|---|
| A channel is being calibrated | "003F" for all bits |
| A communications fault occurred between the module and its owner-controller | "FFFF" for all bits |

Your logic should monitor the Channel Fault bit for a particular output, if you either:

- set the high and low limit alarms outside your operating range

or

- disable output limiting.

## Channel Status Word Bits – Floating Point Mode

Any of the 6 Channel Status words, one for each channel, will display a nonzero condition if that particular channel has faulted for the conditions listed below. Some of these bits set bits in other Fault words.

When the High or Low Limit Alarm bits (bits 1 & 0) in any of the words are set, the appropriate bit is set in the Channel Fault word.

When the Calibration Fault bit (bit 4) is set in any of the words, the Calibration Fault bit (bit 11) is set in the Module Fault word. Table 8.8 lists the conditions that set each of the word bits.

**Table 8.8**

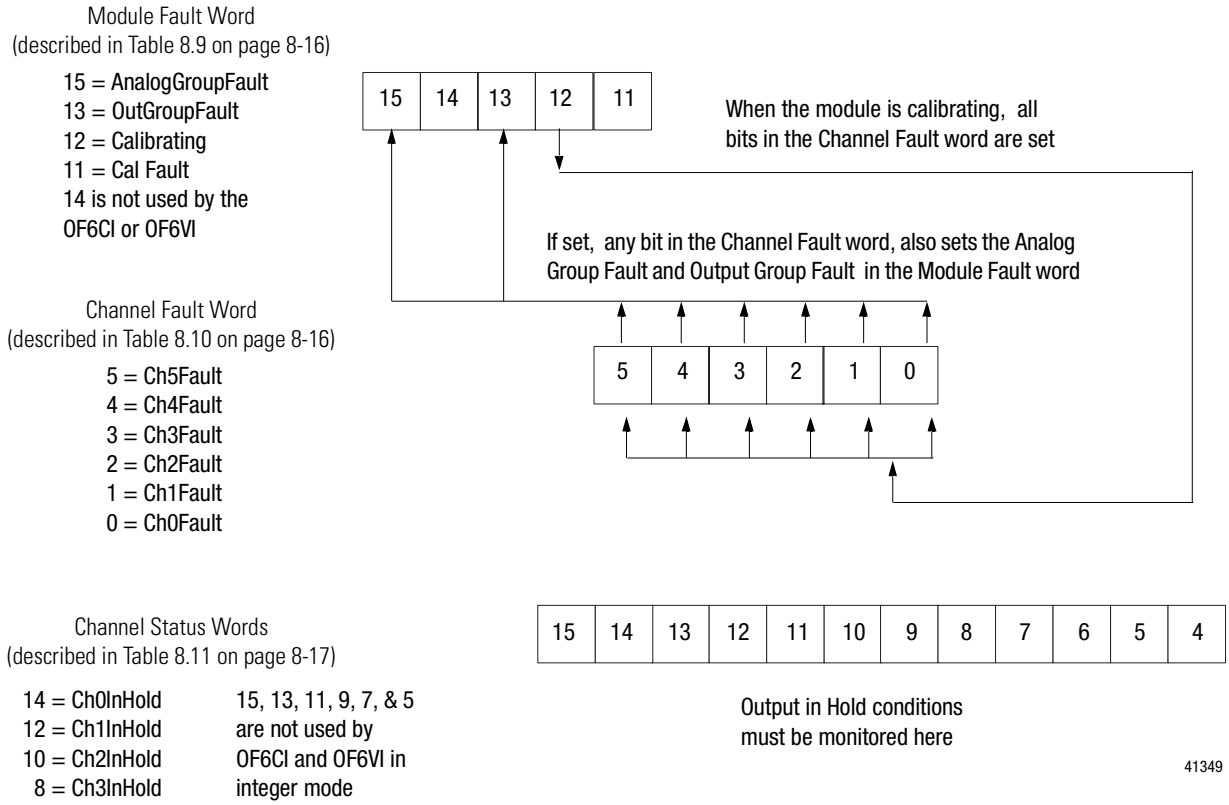
| Tag (Status word): | Bit: | Event that sets this tag: |
|---|---|---|
| ChxNotaNumber | Bit 5 | This bit is set when the output value received from the controller is NotaNumber (the IEEE NAN value). The output channel will hold its last state. |
| ChxCalFault | Bit 4 | This bit is set when an error occurred when calibrating This bit also sets the appropriate bit in the Channel Fault word. |
| ChxInHold | Blt 3 | This bit is set when the output channel is currently holding. The bit resets when the requested Run mode output value is within 0.1% of full-scale of the current echo value. |
| ChxRampAlarm | Bit 2 | This bit is set when the output channel's requested rate of change would exceed the configured maximum ramp rate requested parameter. It remains set until the output reaches its target value and ramping stops. If the bit is latched, it will remain set until it is unlatched. |
| ChxLLimitAlarm | Bit 1 | This bit is set when the requested output value is beneath the configured low limit value. It remains set until the requested output is above the low limit. If the bit is latched, it will remain set until it is unlatched. |
| ChxHLimitAlarm | Bit 0 | This bit is set when the requested output value is above the configured high limit value. It remains set until the requested output is below the high limit. If the bit is latched, it will remain set until it is unlatched. |

**IMPORTANT** Notice that the 1756-OF6CI and 1756-OF6VI modules do not use **bits 6 or 7** in this mode.

## Fault Reporting in Integer Mode

Figure 8.9 offers an overview of the fault reporting process in integer mode.

**Figure 8.9**


Module Fault Word
(described in Table 8.9 on page 8-16)
15 = AnalogGroupFault
13 = OutGroupFault
12 = Calibrating
11 = Cal Fault
14 is not used by the OF6CI or OF6VI
15 14 13 12 11
When the module is calibrating, all bits in the Channel Fault word are set
If set, any bit in the Channel Fault word, also sets the Analog Group Fault and Output Group Fault in the Module Fault word
Channel Fault Word
(described in Table 8.10 on page 8-16)
5 = Ch5Fault
4 = Ch4Fault
3 = Ch3Fault
2 = Ch2Fault
1 = Ch1Fault
0 = Ch0Fault
5 4 3 2 1 0
Channel Status Words
(described in Table 8.11 on page 8-17)
14 = Ch0InHold
12 = Ch1InHold
10 = Ch2InHold
8 = Ch3InHold
6 = Ch4InHold
4 = Ch5InHold
15, 13, 11, 9, 7, & 5 are not used by OF6CI and OF6VI in integer mode
15 14 13 12 11 10 9 8 7 6 5 4
Output in Hold conditions must be monitored here
41349

## Module Fault Word Bits – Integer Mode

In integer mode, Module Fault word bits (bits 15-11) operate exactly as described in floating point mode. Table 8.9 lists tags that are found in the Module Fault Word:

**Table 8.9**

| Tag: | Description: |
|---|---|
| Analog Group Fault | This bit is set when any bits in the Channel Fault word are set. Its tag name is AnalogGroupFault. |
| Output Group Fault | This bit is set when any bits in the Channel Fault word are set. Its tag name is OutputGroupFault. |
| Calibrating | This bit is set when any channel is being calibrated. When this bit is set, all bits in the Channel Fault word are set. Its tag name is Calibrating. |
| Calibration Fault | This bit is set when any of the individual Channel Calibration Fault bits are set. Its tag name is CalibrationFault. |

## Channel Fault Word Bits – Integer Mode

In integer mode, Channel Fault word bits (bits 5-0) operate exactly as described in floating point mode for calibration and communications faults. Table 8.10 lists the conditions that set **all** Channel Fault word bits:

**Table 8.10**

| This condition sets all Channel Fault word bits: | And causes the module to display the following in the Channel Fault word bits: |
|---|---|
| A channel is being calibrated | "003F" for all bits |
| A communications fault occurred between the module and its owner-controller | "FFFF" for all bits |

Your logic should monitor the Channel Fault bit for a particular output, if you either:

- set the high and low limit alarms outside your operating range

or

- disable output limiting.

### Channel Status Word Bits in Integer Mode

The Channel Status word has the following differences when used in integer mode:

- Only the Output in Hold condition is reported by the module.
- Calibration Fault reporting is not available in this word, although the Calibration Fault bit in the Module Fault word will still activate when that condition exists on any channel
- There is only 1 Channel Status word for all 6 channels.

Table 8.11 lists the conditions that set each of the word bits.

**Table 8.11**

| Tag (Status word): | Bit: | Event that sets this tag: |
|---|---|---|
| ChxInHold | Even-numbered bits from bit 14 to bit 0 (e.g. bit 14 represents channel 0).<br><br>For a full listing of the channels these bits represent, see Figure 8.9 on page 8-15. | The Output In Hold bit is set when the output channel is currently holding. The bit resets when the requested Run mode output value is within 0.1% of full-scale of the current echo value. |

**IMPORTANT** Notice that the 1756-OF6CI and 1756-OF6VI modules do not use **bits 15, 13, 11, 9, 7 or 5** in this mode.

## Chapter Summary and What's Next

In this chapter you read about features specific to the Isolated Analog Output Modules (1756-OF6CI & 1756-OF6VI).

Chapter 9 describes Installing ControlLogix I/O Modules.

## Notes:

# Installing ControlLogix I/O Modules

## What this Chapter Contains

This chapter describes how to install ControlLogix modules.


| For information about: | See page: |
|---|---|
| Installing the ControlLogix I/O Module | 9-1 |
| Keying the Removable Terminal Block | 9-3 |
| Connecting Wiring | 9-4 |
| Assembling The Removable Terminal Block and the Housing | 9-8 |
| Installing the Removable Terminal Block onto the Module | 9-9 |
| Removing the Removable Terminal Block from the Module | 9-10 |
| Removing the Module from the Chassis | 9-11 |


## Installing the ControlLogix I/O Module

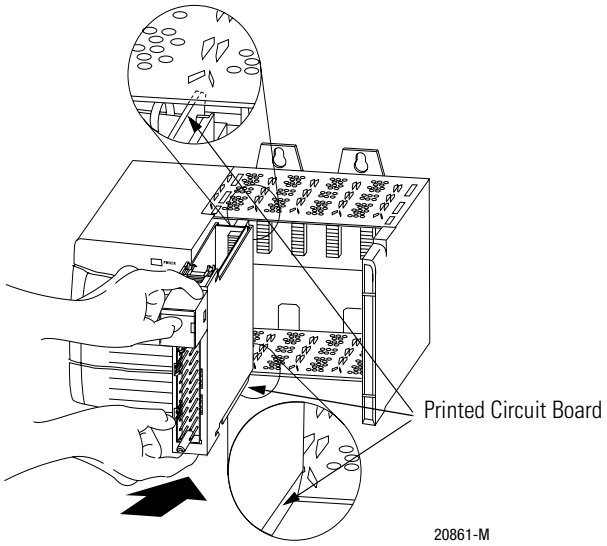
You can install or remove the module while chassis power is applied.

**ATTENTION**

The module is designed to support Removal and Insertion Under Power (RIUP). However, when you remove or insert an RTB with field-side power applied, **unintended machine motion or loss of process control can occur**. Exercise extreme caution when using this feature.

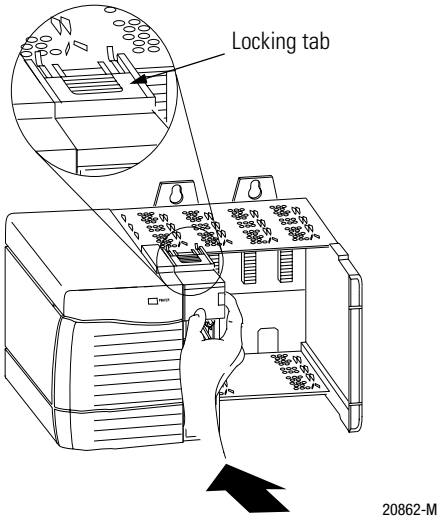
1. Align circuit board with top and bottom chassis guides as shown in Figure 9.1.

**Figure 9.1**




2. Slide module into chassis until module locking tab clicks.

**Figure 9.2**



## Keying the Removable Terminal Block

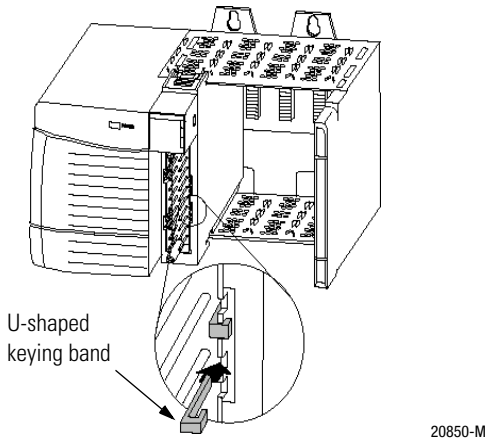
Key the RTB to prevent inadvertently connecting the incorrect RTB to your module. When the RTB mounts onto the module, keying positions will match up.

For example, if you place a U-shaped keying band in position #4 on the module, you cannot place a wedge-shaped tab in #4 on the RTB or your RTB will not mount on the module. We recommend that you use a unique keying pattern for each slot in the chassis.

1. Insert the U-shaped band with the long side near the terminals.

2. Push the band onto the module until it snaps into place.

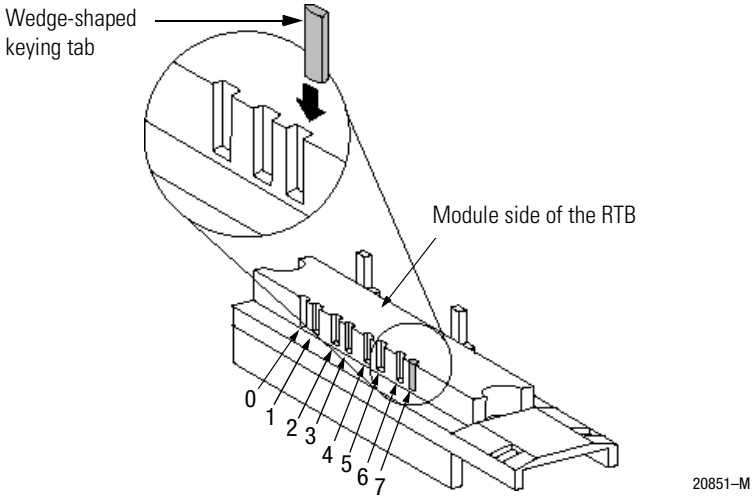
**Figure 9.3**




3. Key the RTB in positions that correspond to unkeyed module positions. Insert the wedge-shaped tab on the RTB with the rounded edge first. Push the tab onto the RTB until it stops.

**IMPORTANT** When keying your RTB and module, you must begin with a wedge-shaped tab in position #6 or #7.

**Figure 9.4**



## Connecting Wiring

You can use an RTB or a Bulletin 1492 prewired Interface Module (IFM)[1] to connect wiring to your module. If you are using an RTB, follow the directions below to connect wires to the RTB. An IFM has been prewired before you received it.

If you are using an IFM to connect wiring to the module, skip this section and go to page 9-8. To see a listing of the IFMs available for use with the ControlLogix analog I/O modules, see Appendix F, Using 1492 Wiring Systems with Your Analog I/O Module

**IMPORTANT** For all ControlLogix analog modules, except the 1756-IR6I, we recommend you use Belden 8761 cable to wire the RTB. For the 1756-IR6I module, we recommend you use Belden 9533 or 83503 cable to wire the RTB. The RTB terminations can accommodate 22-14 gauge shielded wire.

This chapter shows how the general guidelines for wiring your analog I/O modules, including grounding the cable and connecting wiring to each RTB type. For more specific information on wiring individual catalog numbers, refer to Table 9.1.

**Table 9.1 Wiring Diagrams**

| Catalog number: | Wiring diagram on: |
|---|---|
| 1756-IF16 | page 4-15 |
| 1756-IF8 | page 4-19 |
| 1756-IF6CIS | page 5-14 |
| 1756-IF6I | page 5-17 |
| 1756-IR6I | page 6-19 |
| 1756-IT6I | page 6-20 |
| 1756-IT6I2 | page 6-21 |
| 1756-OF4 | page 7-9 |
| 1756-OF8 | page 7-10 |
| 1756-OF6CI | page 8-9 |
| 1756-OF6VI | page 8-10 |

[1] The Bulletin 1492 IFM may not be used in any application that requires agency certification of the ControlLogix system. Use of the IFM violates the UL, CSA and FM certifications of this product.

## Connect Grounded End of the Cable

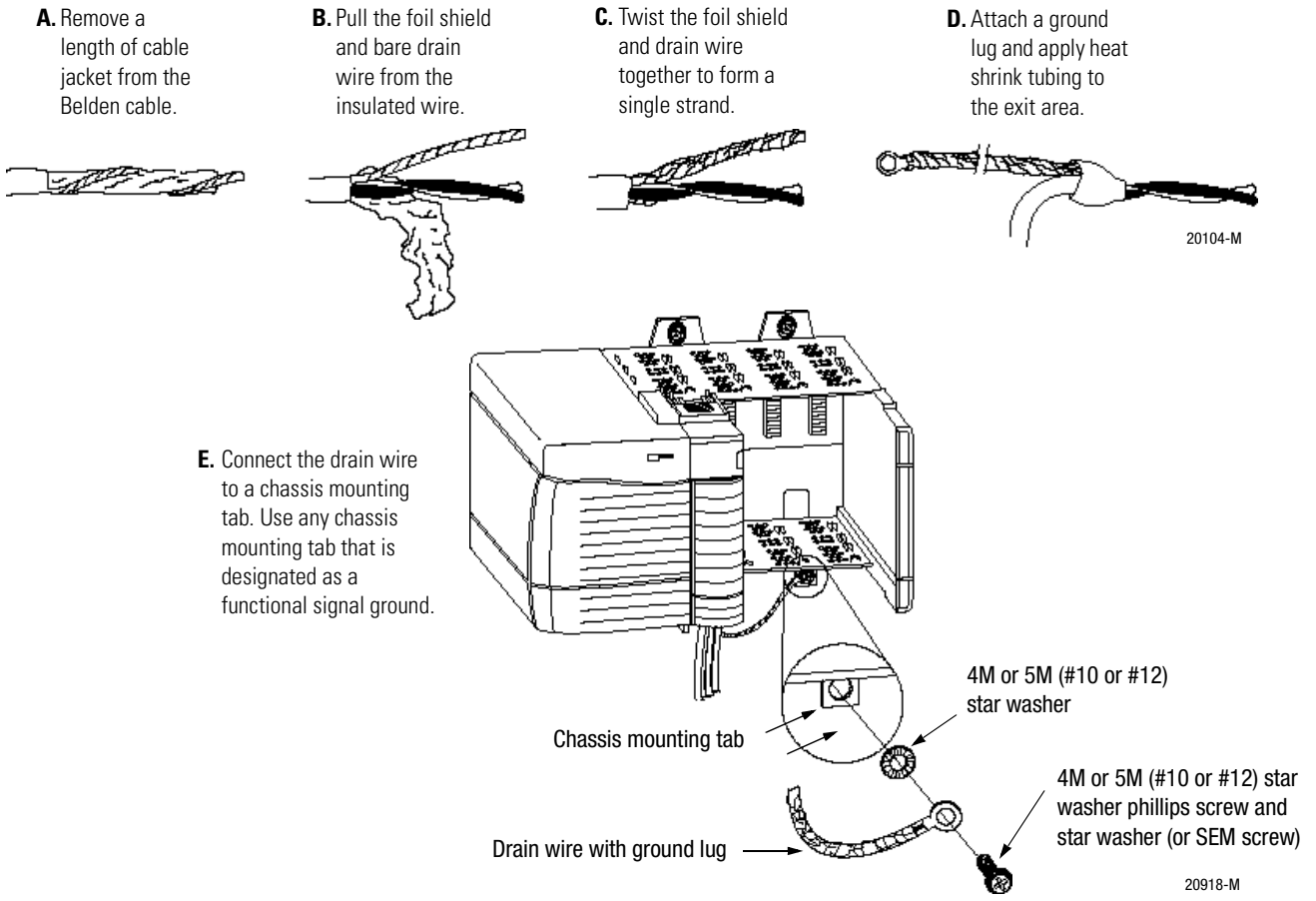
Before wiring the RTB, you must connect ground wiring.

1. Ground the drain wire.

**IMPORTANT** For all ControlLogix analog I/O modules except the 1756-IF6CIS module, we recommend you ground the drain wire at the field-side. If you cannot ground at the field-side, ground at an earth ground on the chassis as shown in Figure 9.5.

For the 1756-IF6CIS, we recommend you ground the module as shown in Figure 9.5.

**Figure 9.5**


A. Remove a length of cable jacket from the Belden cable.
B. Pull the foil shield and bare drain wire from the insulated wire.
C. Twist the foil shield and drain wire together to form a single strand.
D. Attach a ground lug and apply heat shrink tubing to the exit area.
20104-M
E. Connect the drain wire to a chassis mounting tab. Use any chassis mounting tab that is designated as a functional signal ground.
4M or 5M (#10 or #12) star washer
Chassis mounting tab
4M or 5M (#10 or #12) star washer phillips screw and star washer (or SEM screw)
Drain wire with ground lug
20918-M

2. Connect the insulated wires to the field-side.

## Connect Ungrounded End of the Cable

1. Cut the foil shield and drain wire back to the cable casing and apply shrink wrap.

2. Connect the insulated wires to the RTB, as shown below.

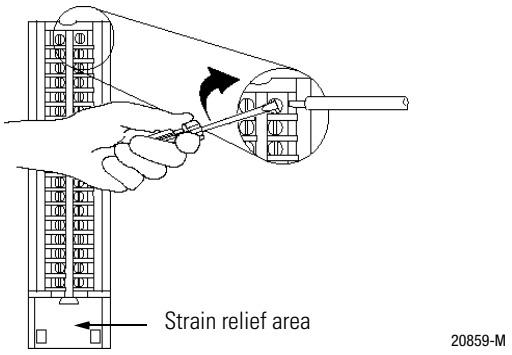
*Three Types of RTBs (each RTB comes with housing)*

- **Cage clamp** - Catalog number 1756-TBCH

1. Insert the wire into the terminal.

2. Turn the screw clockwise to close the terminal on the wire.

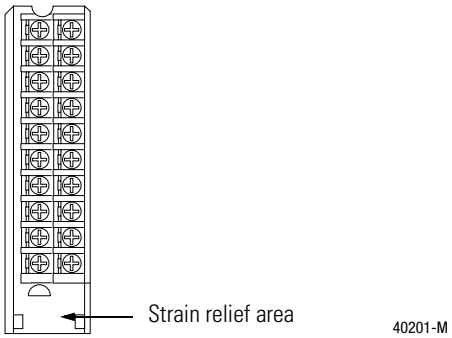
**Figure 9.6**




- **NEMA clamp** - Catalog number 1756-TBNH

Terminate wires at the screw terminals.

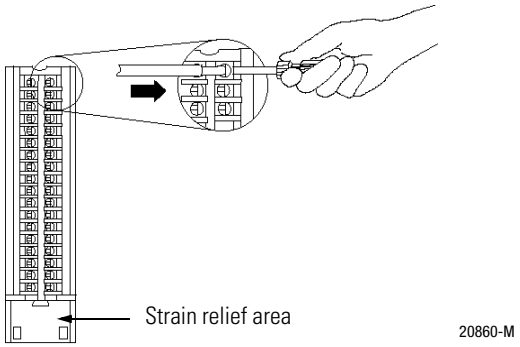
**Figure 9.7**



- **Spring clamp** - Catalog number 1756-TBSH or TBS6H

1. Insert the screwdriver into the outer hole of the RTB.
2. Insert the wire into the open terminal and remove the screwdriver.

**Figure 9.8**




### *Recommendations for Wiring Your RTB*

We recommend you follow these guidelines when wiring your RTB:

1. Begin wiring the RTB at the bottom terminals and move up.
2. Use a tie to secure the wires in the strain relief area of the RTB.
3. Order and use an extended-depth housing (Cat. No.1756-TBE) for applications that require heavy gauge wiring.

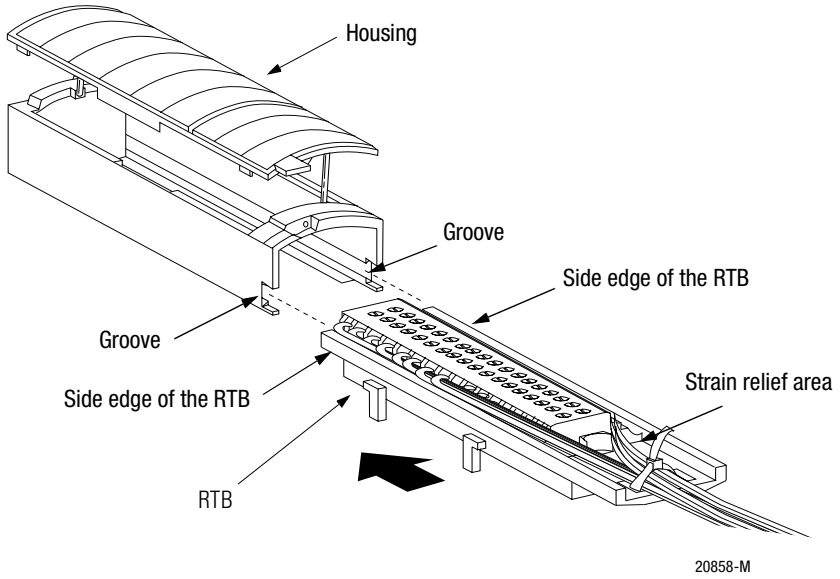
## Assembling The Removable Terminal Block and the Housing

Removable housing covers the wired RTB to protect wiring connections when the RTB is seated on the module.

1. Align the grooves at the bottom of each side of the housing with the side edges of the RTB.

2. Slide the RTB into the housing until it snaps into place.

**Figure 9.9**




**IMPORTANT** If additional wire routing space is required for your application, use extended-depth housing 1756-TBE.

## Installing the Removable Terminal Block onto the Module

Install the RTB onto the module to connect wiring.

**ATTENTION**

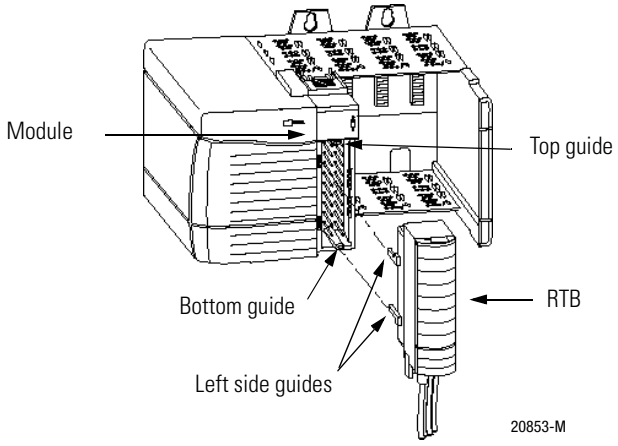
**Shock hazard exists.** If the RTB is installed onto the module while the field-side power is applied, the RTB will be electrically live. Do not touch the RTB's terminals. Failure to observe this caution may cause personal injury.

The RTB is designed to support Removal and Insertion Under Power (RIUP). However, when you remove or insert an RTB with field-side power applied, **unintended machine motion or loss of process control can occur**. Exercise extreme caution when using this feature. It is recommended that field-side power be removed before installing the RTB onto the module.

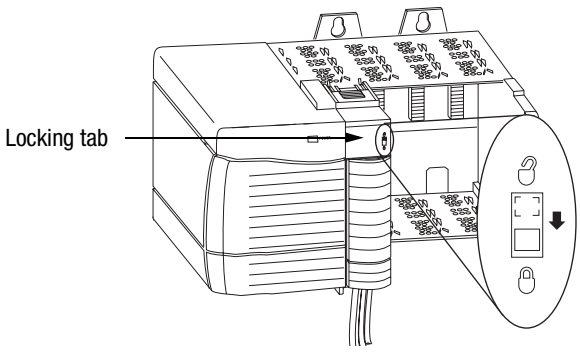
Before installing the RTB, make certain:

- field-side wiring of the RTB has been completed.
- the RTB housing is snapped into place on the RTB.
- the RTB housing door is closed.
- the locking tab at the top of the module is unlocked.

1. Align the top, bottom and left side guides of the RTB with matching guides on the module.




2. Press quickly and evenly to seat the RTB on the module until the latches snap into place.




3. Slide the locking tab down to lock the RTB onto the module.

## Removing the Removable Terminal Block from the Module

If you need to remove the module from the chassis, you must first remove the RTB from the module.

**ATTENTION**

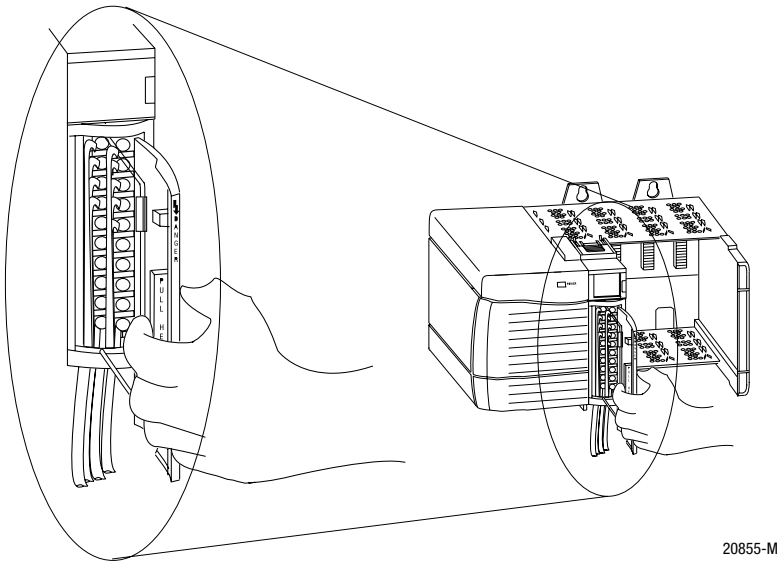
**Shock hazard exists.** If the RTB is removed from the module while the field-side power is applied, the module will be electrically live. Do not touch the RTB's terminals. Failure to observe this caution may cause personal injury.

The RTB is designed to support Removal and Insertion Under Power (RIUP). However, when you remove or insert an RTB with field-side power applied, **unintended machine motion or loss of process control can occur**. Exercise extreme caution when using this feature. It is recommended that field-side power be removed before removing the module.

1. Unlock the locking tab at the top of the module.
2. Open the RTB door using the bottom tab.
3. Hold the spot marked PULL HERE and pull the RTB off the module.

**IMPORTANT** Do not wrap your fingers around the entire door. A shock hazard exists.

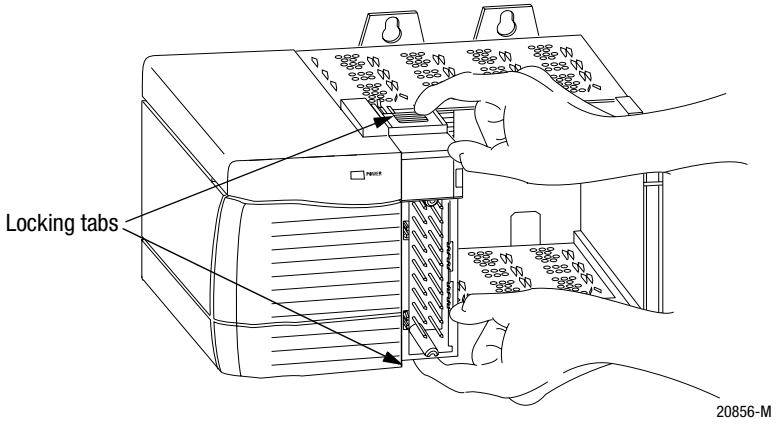
**Figure 9.10**



## Removing the Module from the Chassis

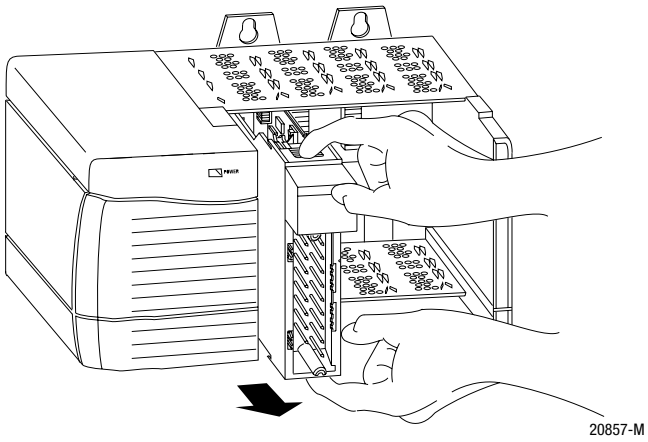
1. Push in the top and bottom locking tabs.

**Figure 9.11**




2. Pull module out of the chassis.

**Figure 9.12**



## Chapter Summary and What's Next

In this chapter you read about Installing ControlLogix I/O Modules.

Chapter 10 describes Configuring ControlLogix Analog I/O Modules.

# Configuring ControlLogix Analog I/O Modules

## What This Chapter Contains

This chapter describes how to configure ControlLogix analog I/O modules.


| For information about: | See page: |
|---|---|
| Using RSLogix 5000 Online Help | 10-1 |
| Configuring Your I/O Module | 10-2 |
| Overview of the Configuration Process | 10-2 |
| Creating a New Module | 10-4 |
| Using the Default Configuration | 10-8 |
| Altering the Default Configuration for Input Modules | 10-9 |
| Altering the Default Configuration for Output Modules | 10-11 |
| Configuring the RTD Module | 10-14 |
| Configuring the Thermocouple Modules | 10-15 |
| Downloading New Configuration Data | 10-16 |
| Editing Configuration | 10-17 |
| Reconfiguring Module Parameters in Run Mode | 10-18 |
| Reconfiguring Parameters in Program Mode | 10-19 |
| Configuring I/O Modules in a Remote Chassis | 10-20 |
| Viewing and Changing Module Tags | 10-22 |


## Using RSLogix 5000 Online Help

This chapter describes how to configure your ControlLogix analog I/O modules but is limited to a relatively brief explanation of how to use the software. For more information on the full capabilities of the software, see the software's online help.

## Configuring Your I/O Module

You must configure your module upon installation. The module will not work until it has been configured.

**IMPORTANT** This chapter focuses on configuring I/O modules in a local chassis. To configure I/O modules in a remote chassis, you must follow all the detailed procedures with two additional steps. An explanation of the additional steps is listed at the end of this chapter.

### RSLogix 5000 Configuration Software

Use RSLogix 5000 software to write configuration for your ControlLogix analog I/O module. You have the option of accepting the default configuration for your module or writing point level configuration specific to your application.

Both options are explained in detail, including views of software screens, in this chapter.

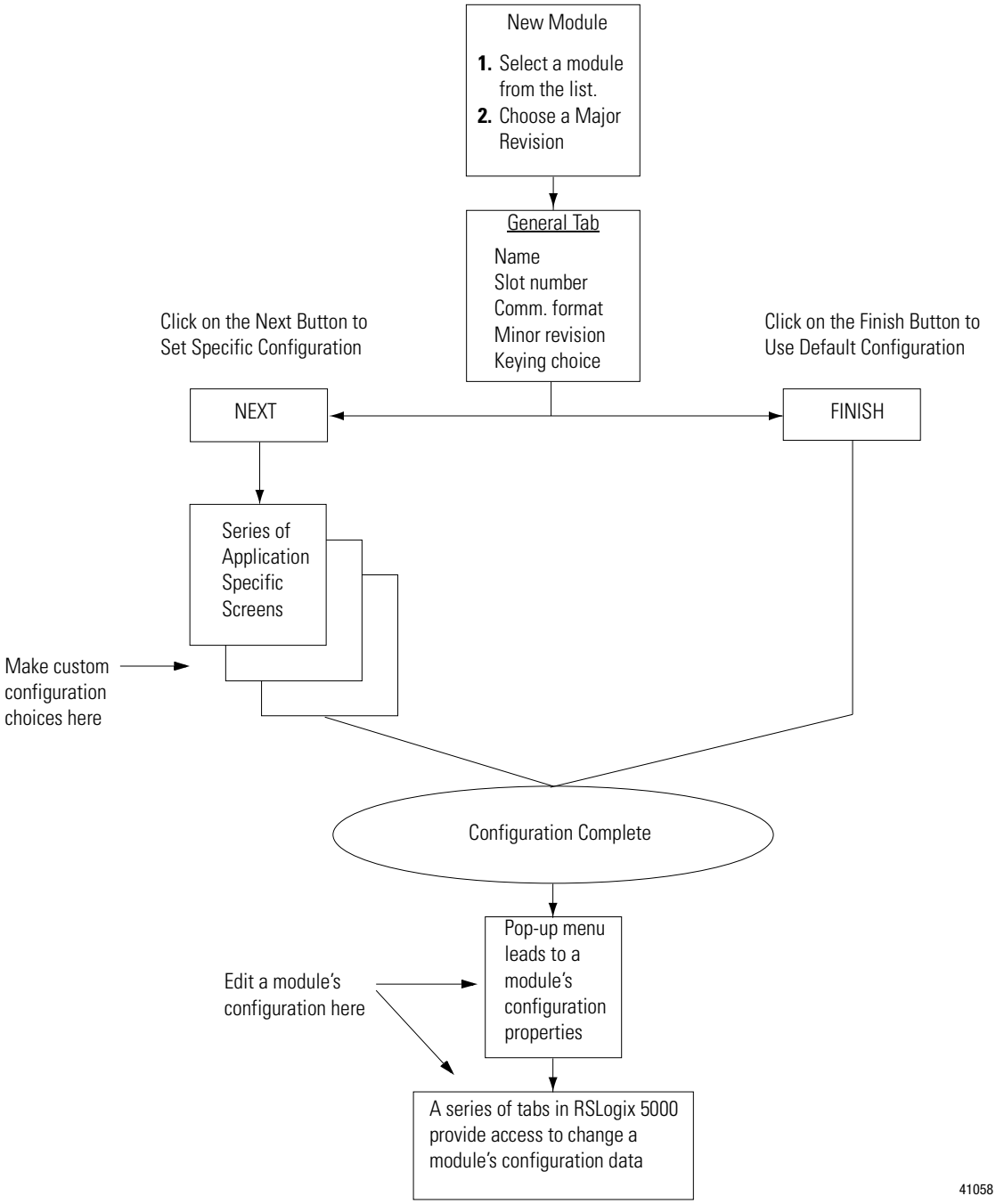
## Overview of the Configuration Process

When you use the RSLogix 5000 software to configure a ControlLogix analog I/O module, you must perform the following steps:

1. Create a new module
2. Accept default configuration or write specific configuration for the module
3. Edit configuration for a module when changes are needed

Figure 10.1 shows an overview of the configuration process.

**Figure 10.1**


New Module
1. Select a module from the list.
2. Choose a Major Revision
General Tab
Name
Slot number
Comm. format
Minor revision
Keying choice
Click on the Next Button to Set Specific Configuration
Click on the Finish Button to Use Default Configuration
NEXT
FINISH
Series of Application Specific Screens
Make custom configuration choices here
Configuration Complete
Pop-up menu leads to a module's configuration properties
Edit a module's configuration here
A series of tabs in RSLogix 5000 provide access to change a module's configuration data
41058

## Creating a New Module

After you have started RSLogix 5000 and created a processor, you must create a new module. The wizard allows you to create a new module and configure it.

**IMPORTANT** You must be offline when you create a new module.

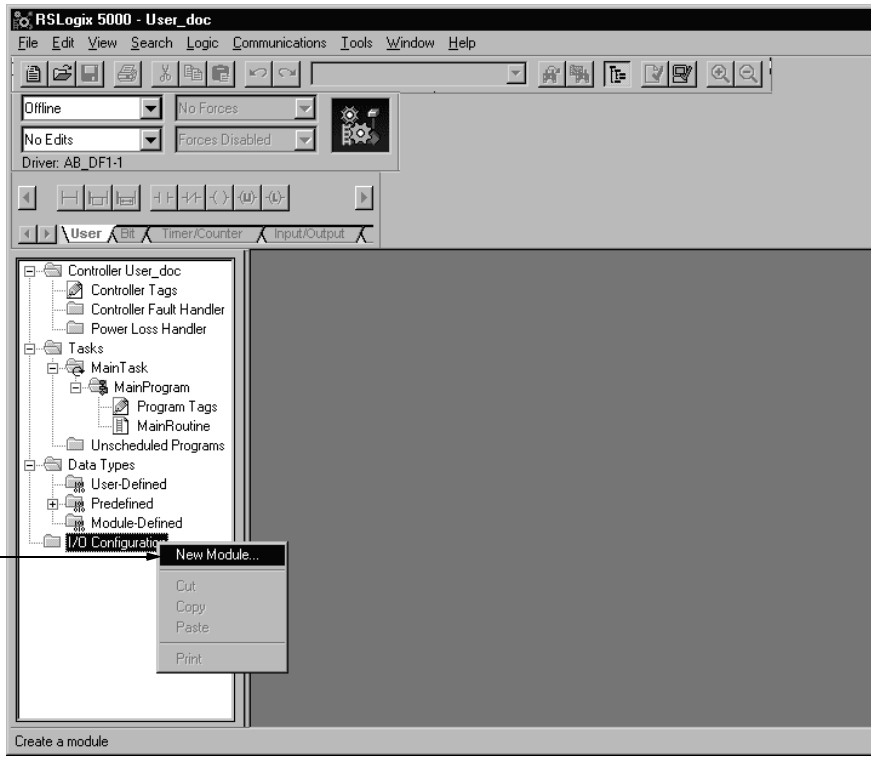
1. If your application is online, go offline.

If you are not offline, use this pull-down menu to go offline

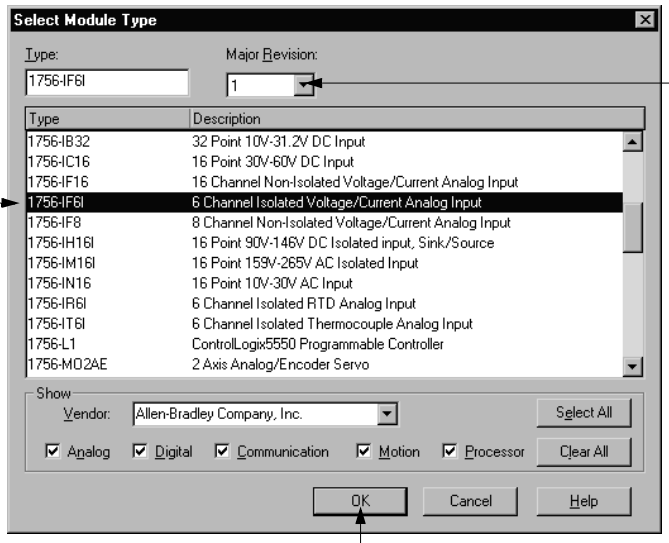
2. Access the Select Module Type screen.

**A.** Right-click on I/O Configuration.

**B.** Select New Module.



**3.** Select the module type.

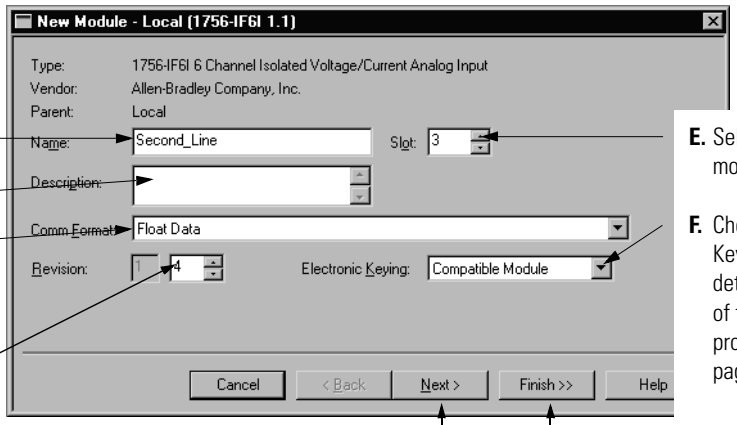



**A.** Select a module.

**B.** Make sure the Major Revision number matches the label on the side of your module

**C.** Select a module.

**4.** Begin configuration on the naming screen.




**A.** Name the module (optional).

**B.** Type a description (optional).

**C.** Choose a Communications Format (A detailed explanation of this field is provided on page 10-6.)

**D.** Make sure the Minor Revision number matches the label on the side of your module.

**E.** Select the slot your module resides in.

**F.** Choose an Electronic Keying method. (A detailed explanation of this field is provided on the next page 3-4.)

If you are altering the default configuration, click here.

Go to page 10-9

If you are using default configuration, click here and you are finished configuring your module.

Go to page 10-8

## Communications Format

The communications format determines:

- what type of configuration options are made available
- what type of data is transferred between the module and its owner-controller
- what tags are generated when configuration is complete
- what type of connection is made between the controller writing the configuration and the module itself.

**IMPORTANT** In addition to description below, each format returns status data and rolling timestamp data.

Also, once the module is created, the communications format cannot be changed. The module must be deleted and recreated.

*Input Module Formats*

Table 10.1 lists the Communications Format available with ControlLogix analog input modules:

**Table 10.1**

| If you want the input module return this data: | Choose this Communications Format: |
|---|---|
| Floating point input data | Float data |
| Integer input data | Integer data |
| Floating point input data with the value of the coordinated system time (from its local chassis) when the input data is sampled | CST timestamped float data |
| Integer input data with the value of the coordinated system time (from its local chassis) when the input data is sampled | CST timestamped integer data |
| Floating point input data with the value of the coordinated system time (from its local chassis) when the input data is sampled when the 1756-IF16 or 1756-IF8 module is operating in the differential mode | CST timestamped float data - differential mode |
| Floating point input data with the value of the coordinated system time (from its local chassis) when the input data is sampled when the 1756-IF16 or 1756-IF8 module is operating in the high speed mode | CST timestamped float data - high speed mode |
| Floating point input data with the value of the coordinated system time (from its local chassis) when the input data is sampled when the 1756-IF16 or 1756-IF8 module is operating in the single-ended mode | CST timestamped float data - single-ended mode |
| Integer input data with the value of the coordinated system time (from its local chassis) when the input data is sampled when the 1756-IF16 or 1756-IF8 module is operating in the differential mode | CST timestamped integer data - differential mode |
| Integer input data with the value of the coordinated system time (from its local chassis) when the input data is sampled when the 1756-IF16 or 1756-IF8 module is operating in the high speed mode | CST timestamped integer data - high speed mode |
| Integer input data with the value of the coordinated system time (from its local chassis) when the input data is sampled when the 1756-IF16 or 1756-IF8 module is operating in the single-ended mode | CST timestamped integer data - single-ended mode |

**Table 10.1**

| If you want the input module return this data: | Choose this Communications Format: |
|---|---|
| Floating point input data when the 1756-IF16 or 1756-IF8 module is operating in the differential mode only | Float data - differential mode |
| Returns floating point input data when the 1756-IF16 or 1756-IF8 module is operating in the high speed mode | Float data - high speed mode |
| Floating point input data when the 1756-IF16 or 1756-IF8 module is operating in the single-ended mode | Float data - single-ended mode |
| Integer input data when the 1756-IF16 or 1756-IF8 module is operating in the differential mode | Integer data - differential mode |
| Integer input data when the 1756-IF16 or 1756-IF8 module is operating in the high speed mode | Integer data - high speed mode |
| Integer input data when the 1756-IF16 or 1756-IF8 module is operating in the single-ended mode | Integer data - single-ended mode |
| Specific input data that is used by a controller that does not own the input module. These choices have the same definition as the similarly-named options above except that they represent listen-only connections between the analog input module and a listen-only controller. | Listen only CST timestamped float data |
| | Listen only CST timestamped integer data |
| | Listen only float data |
| | Listen only integer data |
| | Listen only CST timestamped float data - differential mode |
| | Listen only CST timestamped float data - high speed mode |
| | Listen only CST timestamped float data - single-ended mode |
| | Listen only CST timestamped integer data - differential mode |
| | Listen only CST timestamped integer data - high speed mode |
| | Listen only CST timestamped integer data - single-ended mode |
| | Listen only Float data - differential mode |
| | Listen only Float data - high speed mode |
| | Listen only Float data - single-ended mode |
| | Listen only Integer data - differential mode |
| | Listen only Integer data - high speed mode |
| | Listen only Integer data - single-ended mode |

*Output Module Formats*

Table 10.2 lists the Communications Format available with ControlLogix analog input modules:

**Table 10.2**

| If you want the output module return this data: | Choose this Communications Format: |
|---|---|
| Floating point output data | Float data |
| Integer output data | Integer data |
| Floating point output data and receives data echo values with a CST timestamp value | CST timestamped float data |
| Integer output data and receives data echo values with a CST timestamp value | CST timestamped integer data |
| Specific input data that is used by a controller that does not own the output module. These choices have the same definition as the similarly-named options above except that they represent listen-only connections between the analog output module and a listen-only controller. | Listen only float data |
| | Listen only integer data |
| | Listen only CST timestamped float data |
| | Listen only CST timestamped integer data |

## Electronic Keying

Electronic keying allows the ControlLogix system to control what modules belong in the various slots of a configured system.

During module configuration, you must choose one of the following keying options for your I/O module:

- Exact Match
- Compatible Match
- Disable Keying

For more information on electronic keying, see page 3-4.

# Using the Default Configuration

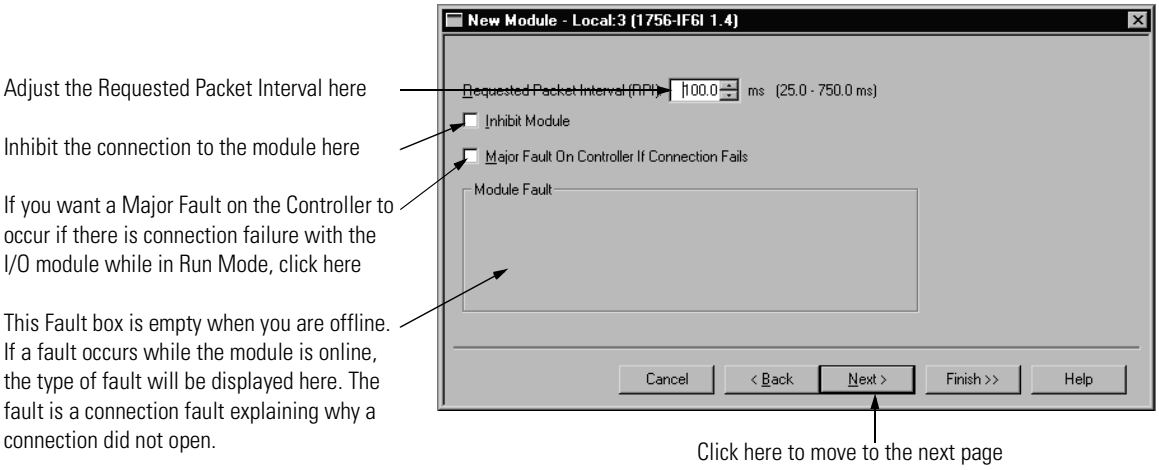
If you use the default configuration and click on Finish, you are done.

## Altering the Default Configuration for Input Modules

If you write specific configuration and click on Next, you see the series of wizard screens that enable you to configure the module. This example shows the process for input modules. To see an example for output modules, see page 10-14.

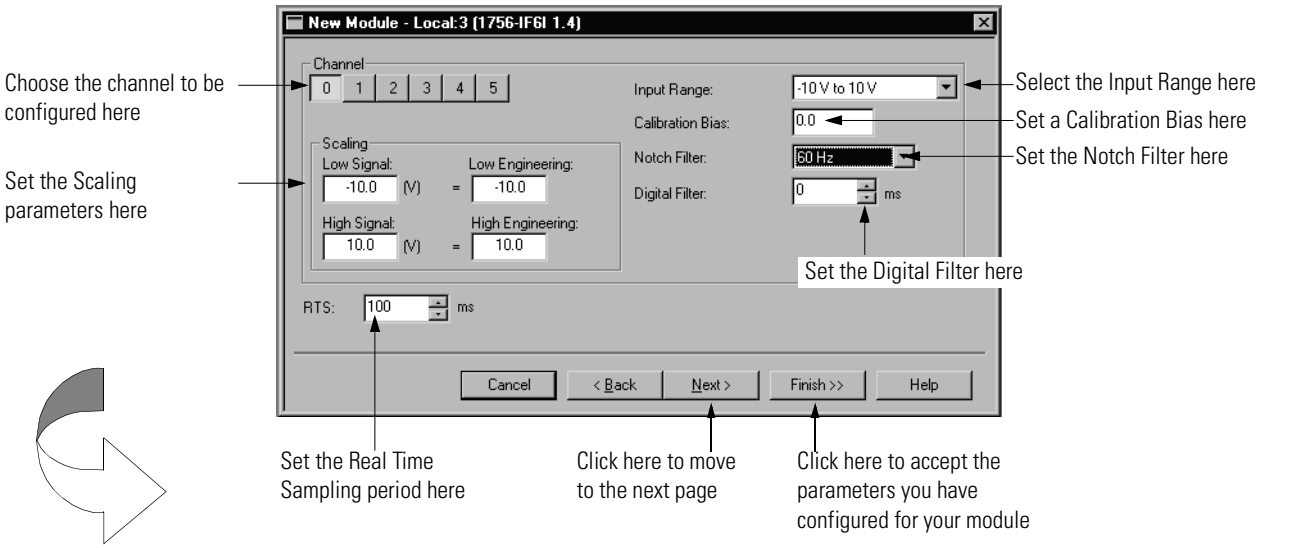
Although each screen maintains importance during online monitoring, some of the screens that appear during this initial module configuration process are blank. They are not shown here. To see these screens in use, see Appendix A.

After the naming page, this series of screens appears.

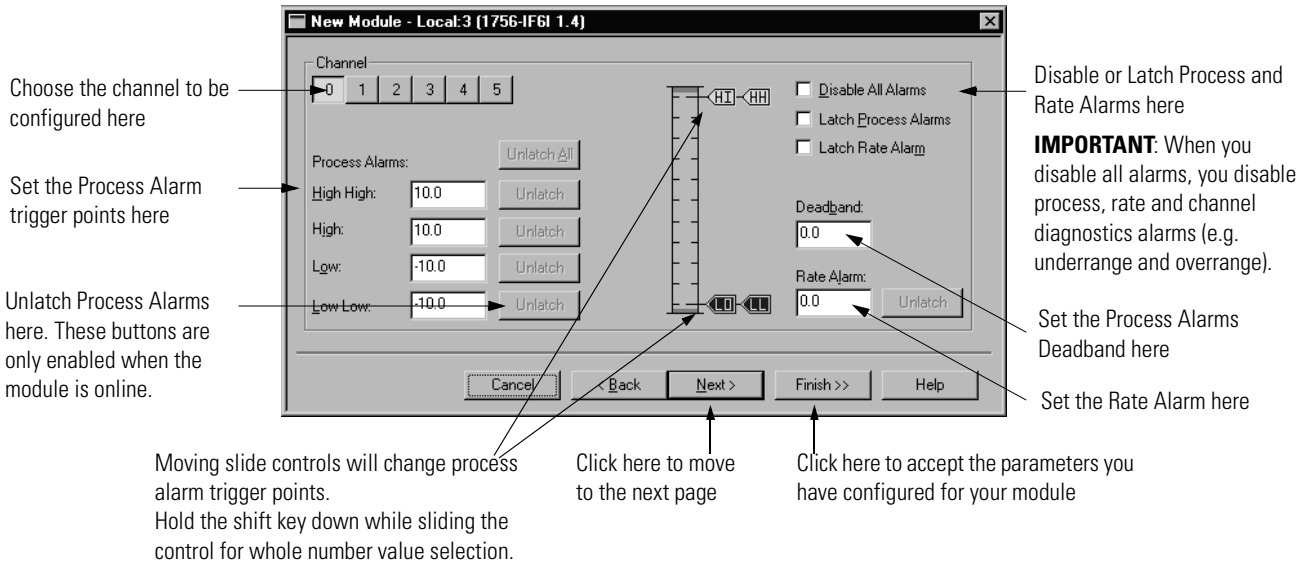

New Module - Local:3 (1756-IF6I 1.4)
Requested Packet Interval (RPI):
100.0
ms (25.0 - 750.0 ms)
Inhibit Module
Major Fault On Controller If Connection Fails
Module Fault
Cancel
< Back
Next >
Finish >>
Help
Adjust the Requested Packet Interval here
Inhibit the connection to the module here
If you want a Major Fault on the Controller to occur if there is connection failure with the I/O module while in Run Mode, click here
This Fault box is empty when you are offline. If a fault occurs while the module is online, the type of fault will be displayed here. The fault is a connection fault explaining why a connection did not open.
Click here to move to the next page

The configuration page appears next. For example, this screen appears for the 1756-IF6I module. The choices available on the configuration screen vary according to the module selected.

**IMPORTANT**: Set all the configuration parameters for each channel on this page before moving to the next page




**IMPORTANT**: Set all the configuration parameters for each channel on this page before moving to the next page

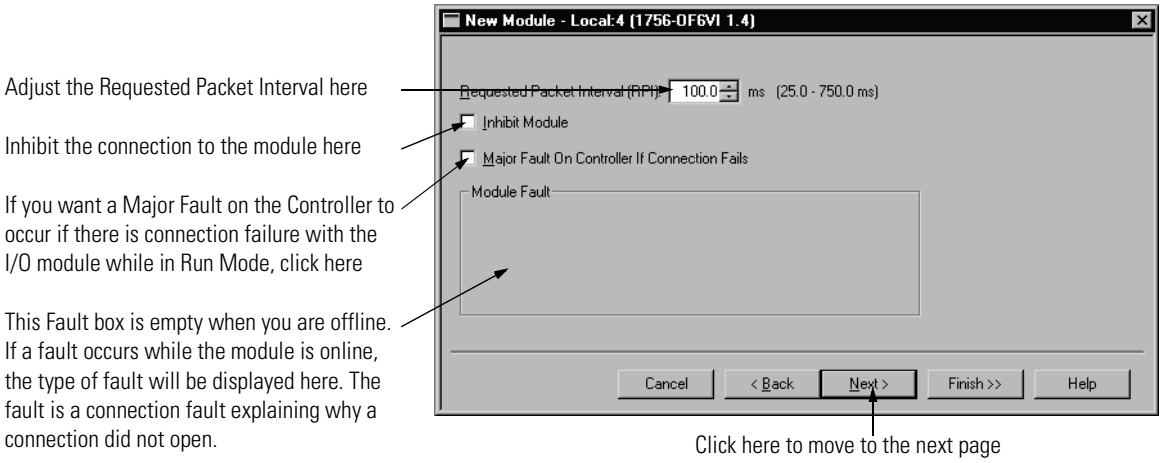


## Altering the Default Configuration for Output Modules

If you write specific configuration and click on Next, you see the series of wizard screens that enable you to configure the module. This example shows the process for output modules.

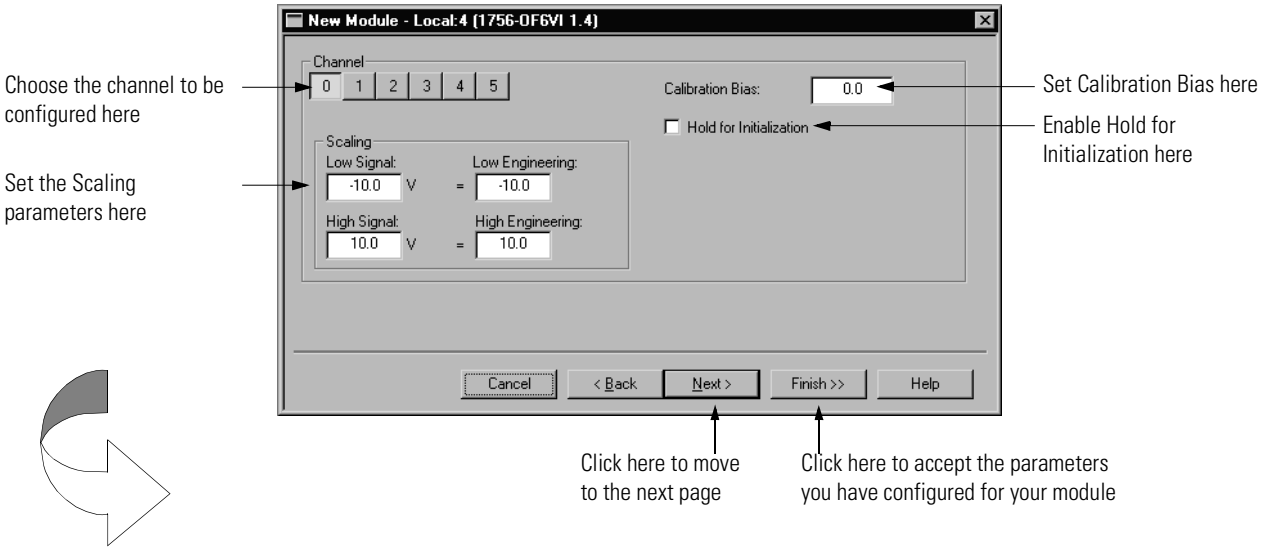
Although each screen maintains importance during online monitoring, some of the screens that appear during this initial module configuration process are blank. They are not shown here. To see these screens in use, see Appendix A.

After the naming page, this series of screens appears.

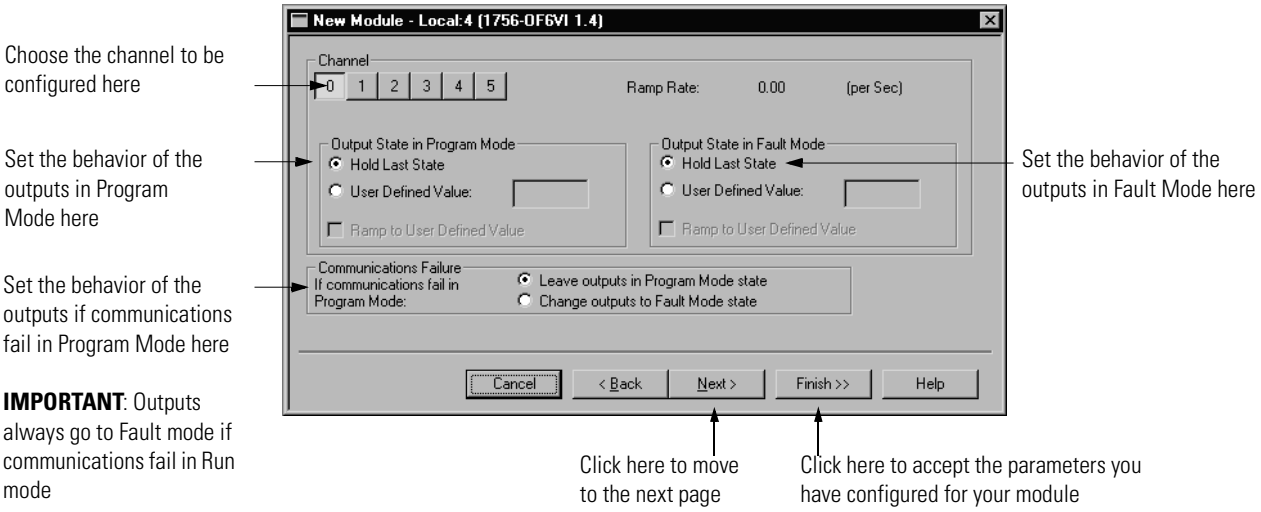

Adjust the Requested Packet Interval here
Inhibit the connection to the module here
If you want a Major Fault on the Controller to occur if there is connection failure with the I/O module while in Run Mode, click here
This Fault box is empty when you are offline. If a fault occurs while the module is online, the type of fault will be displayed here. The fault is a connection fault explaining why a connection did not open.
New Module - Local:4 (1756-OF6VI 1.4)
Requested Packet Interval (RPI):
100.0
ms (25.0 - 750.0 ms)
Inhibit Module
Major Fault On Controller If Connection Fails
Module Fault
Cancel
< Back
Next >
Finish >>
Help
Click here to move to the next page

The configuration page appears next. For example, this screen appears for the 1756-OF6VI module. The choices available on the configuration screen vary according to the module selected.

**IMPORTANT**: Set all the configuration parameters for each channel on this page before moving to the next page



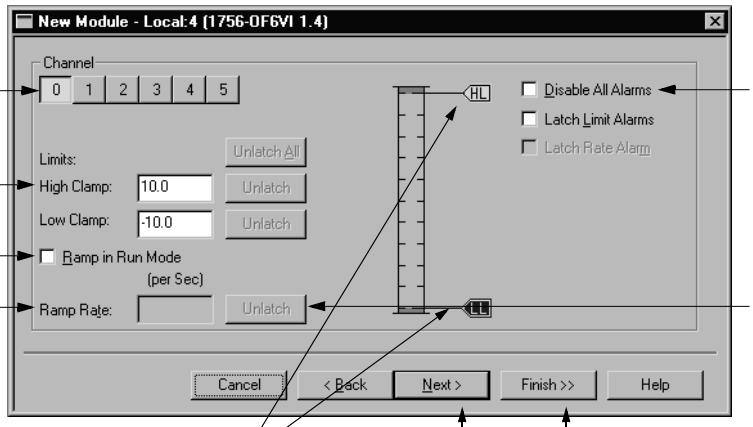

**IMPORTANT**: Set all the configuration parameters for each channel on this page before moving to the next page


New Module - Local:4 (1756-OF6VI 1.4)
Channel
0 1 2 3 4 5
Ramp Rate:
0.00
(per Sec)
Output State in Program Mode
Hold Last State
User Defined Value:
Ramp to User Defined Value
Output State in Fault Mode
Hold Last State
User Defined Value:
Ramp to User Defined Value
Communications Failure
If communications fail in Program Mode:
Leave outputs in Program Mode state
Change outputs to Fault Mode state
Cancel
< Back
Next >
Finish >>
Help
Choose the channel to be configured here
Set the behavior of the outputs in Program Mode here
Set the behavior of the outputs if communications fail in Program Mode here
Set the behavior of the outputs in Fault Mode here
Click here to move to the next page
Click here to accept the parameters you have configured for your module

**IMPORTANT**: Outputs always go to Fault mode if communications fail in Run mode

These screens appear next.

**IMPORTANT**: Set all the configuration parameters for each channel on this page before moving to the next page




Choose the channel to be configured here

Set Clamp Limits here

Select Ramp in Run here

Set Ramp Rate here

Disable or latch limit Ramp and Rate Alarms here

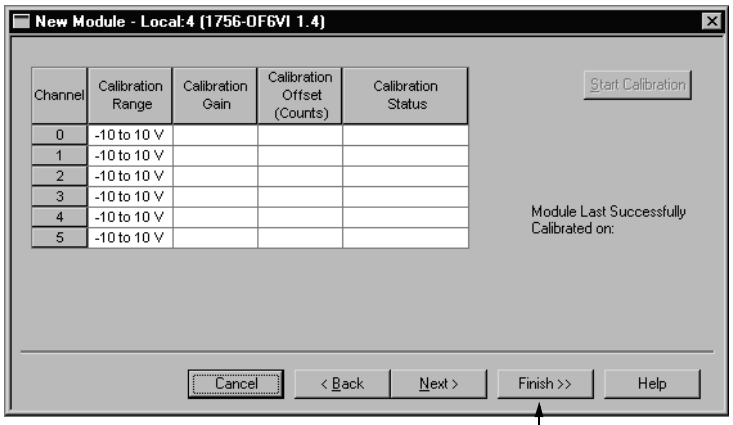
Unlatch Process Alarms here. These buttons are only enabled when the module is online.

Moving slide controls changes the Clamp Limit trigger points. Hold the shift key down while sliding the control for easier value selection.

Click here to move to the next page

Click here to accept the parameters you have configured for your module

**IMPORTANT**: The last two screens only appear if you click on Next after setting the process alarms above




This screen appears next in the wizard series of screens. It is used during calibration but not initial configuration

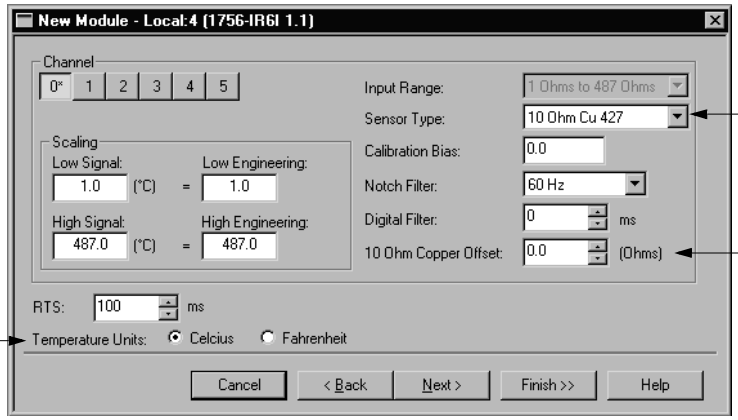
Click here to accept the parameters you have configured for your module

## Configuring the RTD Module

The RTD module (1756-IR6I) has additional configurable points, temperature units and 10Ω copper offset options.

All of this module's configuration screens match the series listed for input modules beginning on page 10-9 except for the third screen. The screen below shows the aforementioned screen for the 1756-IR6I module.

**IMPORTANT**: Set all the configuration parameters for each channel on this page before moving to the next page All configurable options are the same except for the addition of those features that account for the module's temperature measuring capability. They are shown below.




Select RTD Sensor Type here

Select 10 Ohm Copper Offset here

This feature only needs to be set if you choose a Copper Sensor Type

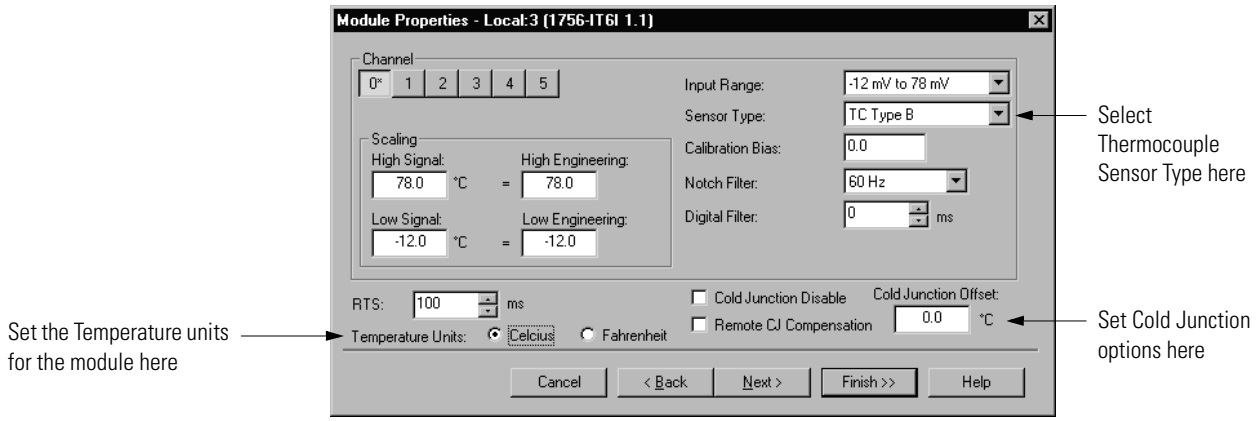
Set the Temperature units for the module here

## Configuring the Thermocouple Modules

The 1756-IT6I and 1756-IT6I2 modules have additional configurable points, temperature units and cold junction options.

All of this module's configuration screens match the series listed for input modules beginning on page 10-9 except for the third screen. The screen below shows the aforementioned screen for the 1756-IT6I module.

**IMPORTANT**: Set all the configuration parameters for each channel on this page before moving to the next page. All configurable options are the same except for the addition of those features that account for the module's temperature measuring capability. They are shown below.




**IMPORTANT**

The module sends back temperature values over the entire sensor range as long as the High signal value equals the High engineering value and the Low signal value equals the Low engineering value.

For the example above, if:

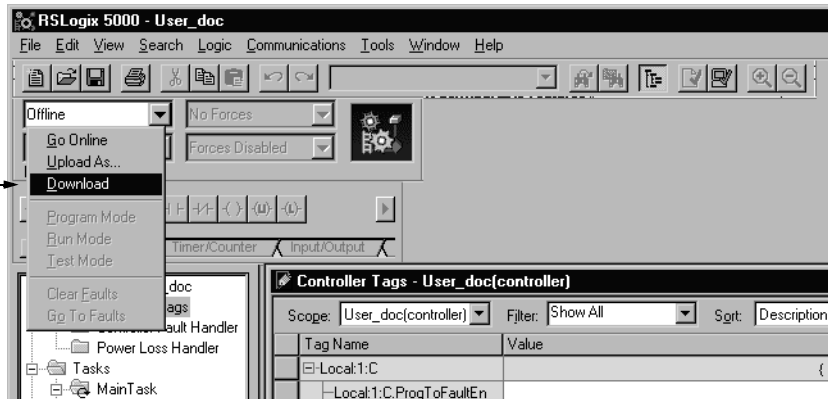
High Signal = 78.0°C, High Engineering must = 78.0.

Low signal = -12.0°C, Low Engineering must = -12.0

## Downloading New Configuration Data

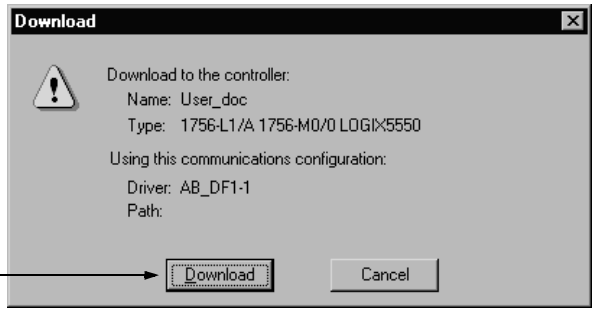
After you have changed the configuration data for a module, the change does not actually take affect until you download the new program which contains that information. This downloads the entire program to the controller overwriting any existing programs.

Pull down this menu and click here to download the new data




RSLogix 5000 verifies the download process with this pop-up screen.

Click here to download new data




This completes the download process.

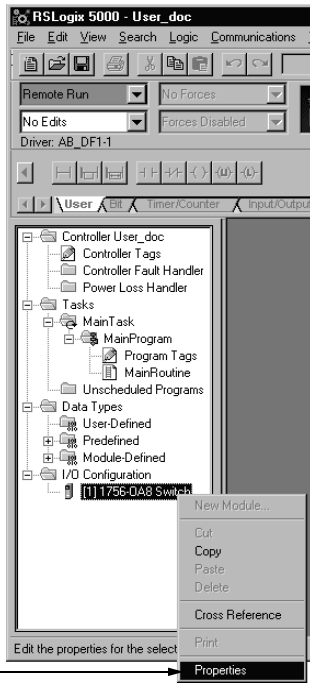
## Editing Configuration

After you set configuration for a module, you can review and change it. You can change configuration data and download it to the controller while online. This is called **dynamic reconfiguration**.

Your freedom to change some configurable features, though, depends on whether the controller is in Remote Run Mode or Program Mode.

**IMPORTANT** Although you can change configuration while online, you must go offline to add or delete modules from the program in current RSLogix 5000 revisions.

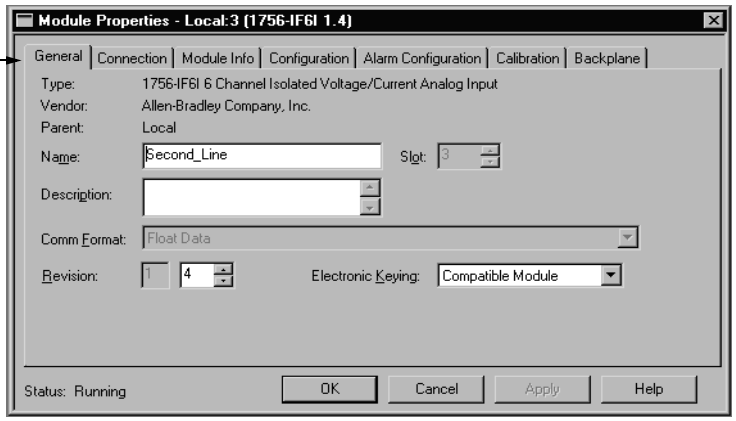
The editing process begins on the main page of RSLogix 5000.




**A.** Right-click on the module.

**B.** Select Properties.

You see this screen.




Click on the tab of the page you want to view or reconfigure

## Reconfiguring Module Parameters in Run Mode

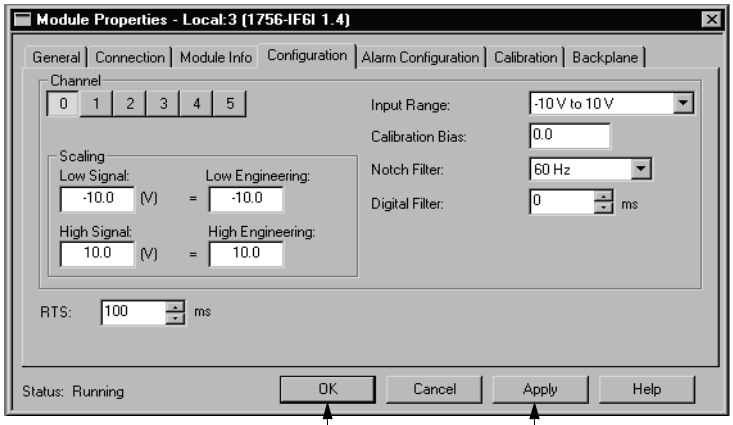
Your module can operate in Remote Run Mode or Hard Run Mode. You can only change any configurable features that are enabled by the software in Remote Run Mode.

If any feature is disabled in either Run Mode, change the controller to Program Mode and make the necessary changes.

For example, the following screen shows the configuration page for the 1756-IF6I module while it is in Run Mode.

**A.** Make the necessary configuration changes

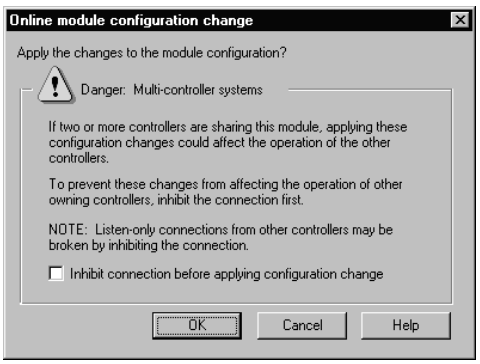
In this example, all configurable features are enabled in Run Mode.




**B.** Click here to transfer the new data and close the screen.

Click here to transfer the new data and keep the screen open.

When you try to download new configuration data to the module, the following warning appears.

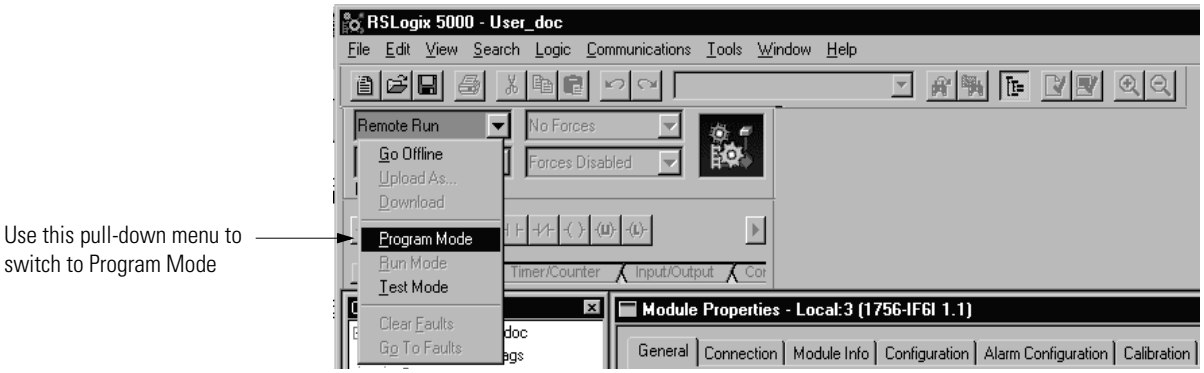

Online module configuration change
Apply the changes to the module configuration?
Danger: Multi-controller systems
If two or more controllers are sharing this module, applying these configuration changes could affect the operation of the other controllers.
To prevent these changes from affecting the operation of other owning controllers, inhibit the connection first.
NOTE: Listen-only connections from other controllers may be broken by inhibiting the connection.
Inhibit connection before applying configuration change
OK
Cancel
Help

**IMPORTANT** If you change the configuration for a module, you must consider whether the module has more than one owner-controller. If so, be sure each owner has exactly the same configuration data as the others.

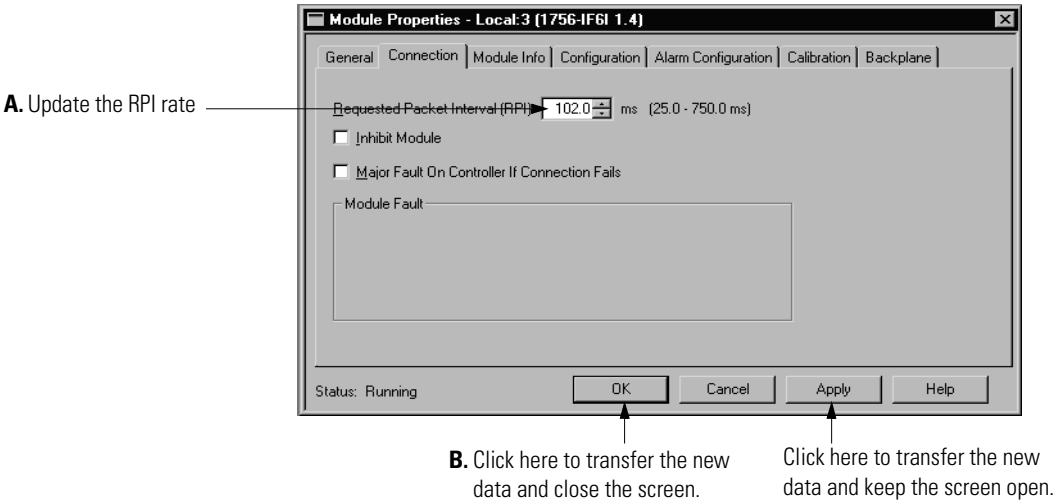
For more information on changing configuration in a module with multiple owner-controllers, see page 2-13.

## Reconfiguring Parameters in Program Mode

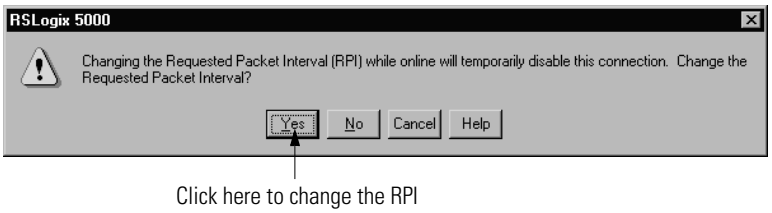
Change the module from Run Mode to Program Mode before changing configuration in the Program Mode.




Make any necessary changes. For example, the RPI can only be changed in Program Mode.




Before the RPI rate is updated online, RSLogix 5000 verifies your desired change.


RSLogix 5000
Changing the Requested Packet Interval (RPI) while online will temporarily disable this connection. Change the Requested Packet Interval?
Yes
No
Cancel
Help
Click here to change the RPI

The RPI has been changed and the new configuration data has been transferred to the controller.

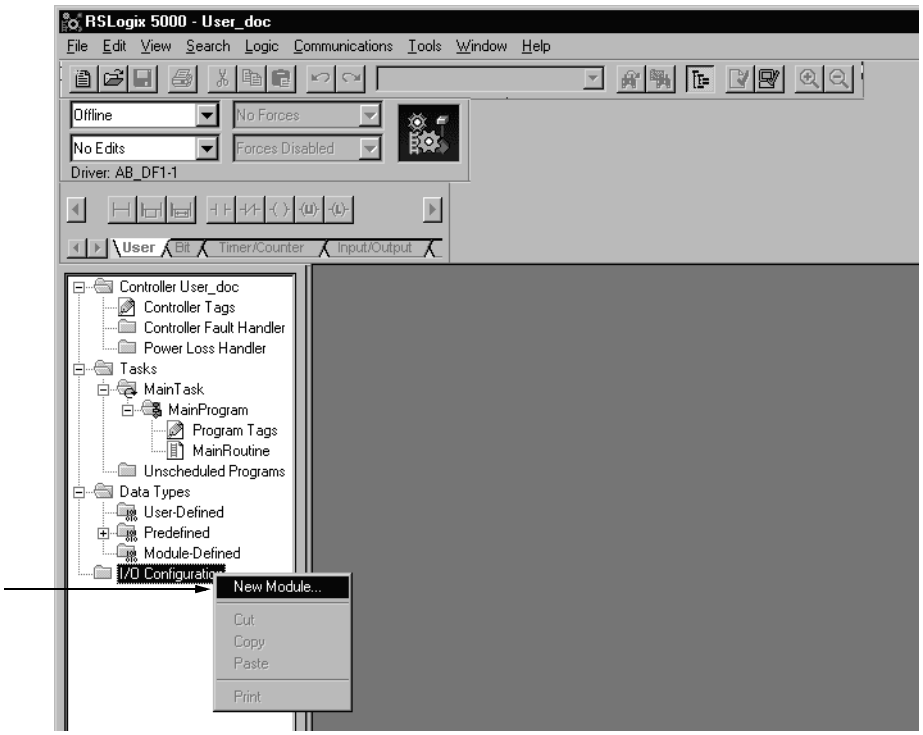
After you change your module's configuration in Program Mode, we recommend that you change the module back to Run Mode.

## Configuring I/O Modules in a Remote Chassis

ControlLogix ControlNet Interface modules (1756-CNB or 1756-CNBR) or EtherNet/IP Bridge module (1756-ENBT) are required to communicate with I/O modules in a remote chassis.

You must configure the communications module in the local chassis and the remote chassis before adding new I/O modules to the program.

1. Configure a communications module for the local chassis. This module handles communications between the controller chassis and the remote chassis.




**A.** Right-click on I/O Configuration.

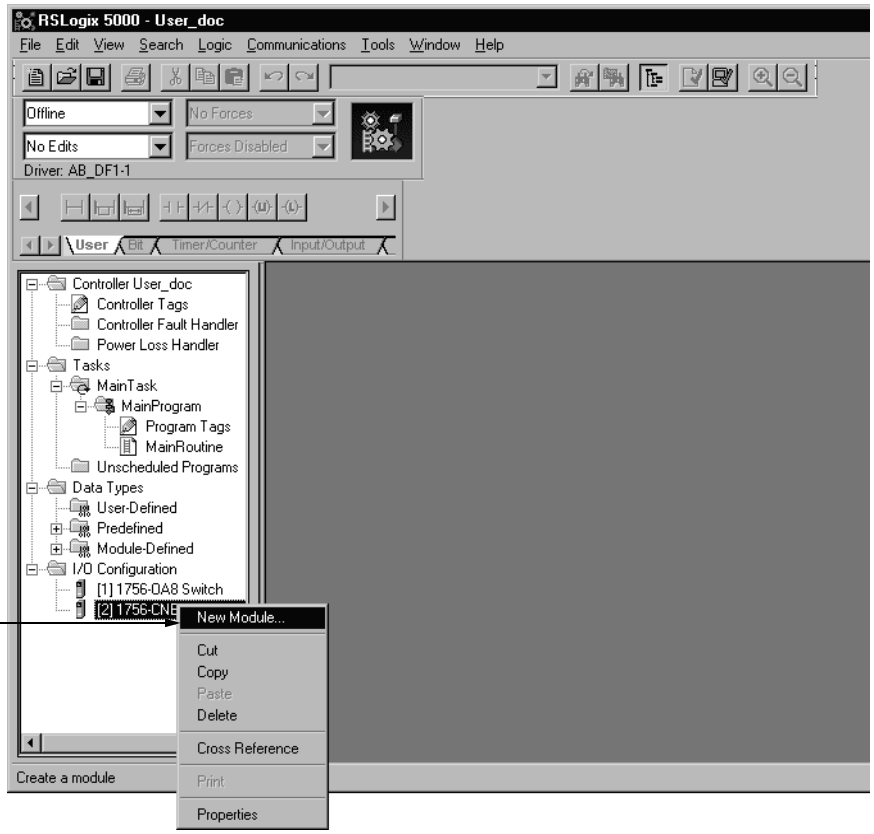
**B.** Select New Module.

2. Choose a communications module and configure it.

   For more information on the ControlLogix ControlNet Interface modules, see the ControlLogix ControlNet Interface user manual, publication 1756-6.5.3.

   For more information on the ControlLogix EtherNet/IP Bridge module, see the ControlLogix EtherNet/IP Bridge module user manual, publication 1756-UM050.

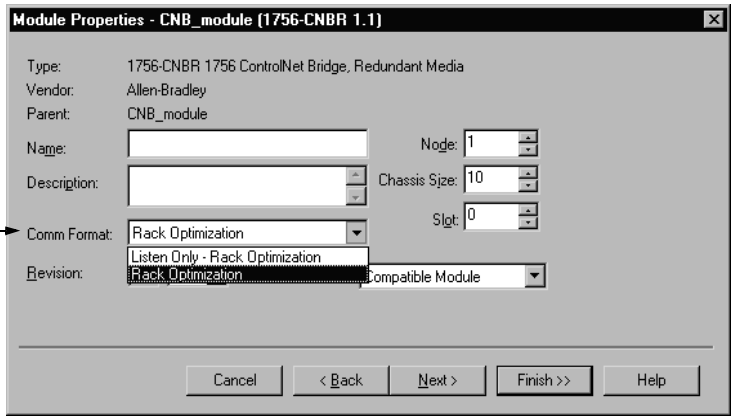
**3.** Configure a communications module for the remote chassis.




**A.** Right-click on the local communications module.

**B.** Select New Module.

**4.** Choose a communications module and configure it.




**IMPORTANT**: Be aware of the two Communications Format choices available for 1756-CNB modules. For more information on the differences between Rack Optimization and Listen-Only Rack Optimization, see chapter 2 of the ControlLogix Digital I/O Modules User Manual, publication 1756-UM058.

Now you can configure the remote I/O modules by adding them to the remote communications module. Follow the same procedures as you do for configuring local I/O modules as detailed earlier in this chapter.

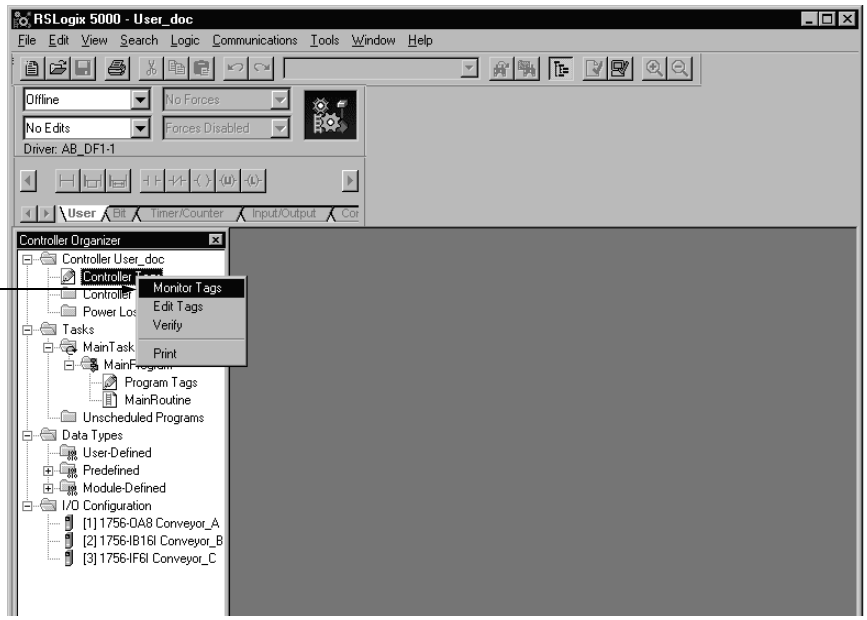
## Viewing and Changing Module Tags

When you create a module, you establish a series of tags in the ControlLogix system that can be viewed in the Tag Editor of RSLogix 5000. Each configurable feature on your module has a distinct tag that can be used in the processor's ladder logic.

You can access a module's tags through RSLogix 5000 as shown below.

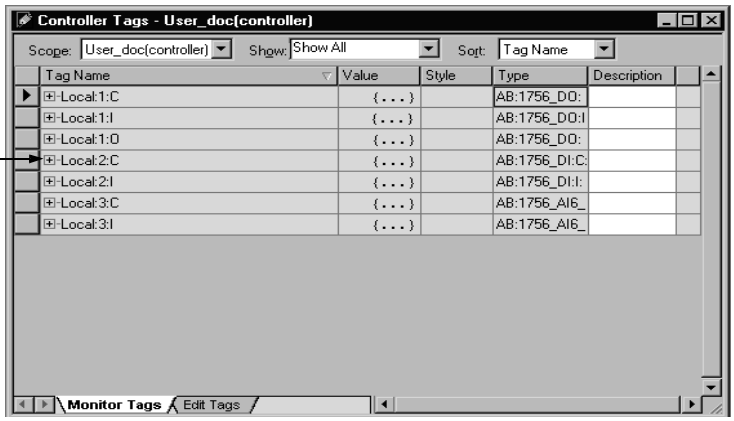
**A.** Right-click on Controller Tags.

**B.** Select Monitor Tags.




You can view the tags from here.

Click on the slot number of the module you want to see




Because the process of viewing and changing a module's configuration tags is broader in scope than can be addressed in this chapter.

For more information and sample tag collections, see Appendix B, Tag Definitions.

## Chapter Summary and What's Next

In this chapter, you read about Configuring ControlLogix Analog I/O Modules.

Chapter 11 explains Calibrating the ControlLogix Analog I/O Modules.

## Notes:

# Calibrating the ControlLogix Analog I/O Modules

## What This Chapter Contains

This chapter describes how to calibrate ControlLogix analog modules.


| For information about: | See page: |
|---|---|
| Difference Between Calibrating An Input Module and Calibrating An Output Module | 11-2 |
| Calibrating Input Modules | 11-4 |
| Calibrating Output Modules | 11-22 |


Your ControlLogix analog I/O module comes from the factory with a default calibration. You may choose to recalibrate your module to increase its accuracy for your specific application.

You do not have to configure a module before you calibrate it. If you decide to calibrate your analog I/O modules first, you must add them to your program. To see how to add a new module to your program, see page 10-4.

**IMPORTANT**

Analog I/O modules can be calibrated on a channel by channel basis or with the channels grouped together. Regardless of which option you choose, we recommend you calibrate all channels on your module each time you calibrate. This will help you maintain consistent calibration readings and improve module accuracy.

Calibration is meant to correct any hardware inaccuracies that may be present on a particular channel. The calibration procedure compares a known standard, either input signal or recorded output, with the channel's performance and then calculating a linear correction factor between the measured and the ideal.

The linear calibration correction factor is applied on every input or output same to obtain maximum accuracy.

## Difference Between Calibrating An Input Module and Calibrating An Output Module

Although the purpose of calibrating analog modules is the same for input and output modules, to improve the module's accuracy and repeatability, the procedures involved differs for each.

- When you calibrate input modules, you use current, voltage or ohms calibrators to send a signal to the module to calibrate it.
- When you calibrate output modules, you use a digital multimeter (DMM) to measure the signal the module is sending out.

To maintain your module's accuracy specifications, we recommend you use calibration instruments with specific ranges. Table 11.1 lists the recommended instruments for each module.

**Table 11.1 Recommended Calibration Instruments for 1756 Analog I/O Modules**

| Modules: | Recommended instrument ranges: |
|---|---|
| 1756-IF16 & 1756-IF8 | 0 to 10.25V source +/-150μV Voltage |
| 1756-IF6CIS | 1.00 to 20.00mA source +/-0.15μA Current |
| 1756-IF6I | 0 to 10.00V source +/-150μV Voltage<br>1.00 to 20.00mA source +/-0.15μA Current |
| 1756-IR6I | 1.0 and 487.0Ω resistors(1) +/-0.01% |
| 1756-IT6I & 1756-IT6I2 | -12mV to 78mV source +/-0.3μV |
| 1756-OF4 1756-OF8 | DMM better than 0.3mV or 0.6μA |
| 1756-OF6VI | DMM with resolution better than 0.5mV |
| 1756-OF6CI | DMM with resolution better than 1.0μA |

(1) We suggest you use the following precision resistors:
KRL Electronics - 534A1-1R0T 1.0 Ohm 0.01% / 534A1-487R0T 487 Ohm 0.01%

A precision decade resistor box can also be used that meets or exceeds the required accuracy specifications. The user is responsible for assuring that the decade box maintains accuracy by periodic calibration as specified by the following vendors:
Electro Scientific Industries, Portland, OR – Series DB 42
IET Labs, Westbury, NY – HARS-X Series
Julie Research Labs, New York, NY – DR100 Series

**IMPORTANT**

If you calibrate your module with an instrument that is less accurate than those recommended in Table 11.1 (e.g. calibrate a 1756-IF16 module with a voltage calibrator of greater than +/-150μV accuracy), the following may occur:

- Calibration appears to occur normally but the module gives inaccurate data during operation.

or

- A calibration fault occurs, forcing you to abort calibration.
- The calibration fault bits are set for the channel you attempted to calibrate. The bits remain set until a valid calibration is completed.

  In this case, you must recalibrate the module with an instrument as accurate as recommended in Table 11.1.

## Calibrating in Either Program or Run Mode

You must be online to calibrate your analog I/O modules through RSLogix 5000. When you are online, you can choose either Program or Run Mode as the state of your program during calibration.

We recommend that your module be in Program Mode and not be actively controlling a process when you calibrate it.

**IMPORTANT**

The module freezes the state of each channel and does not update the controller with new data until after calibration ends. This could be hazardous if active control were attempted during calibration.

## Calibrating Input Modules

Input calibration is a multi-step process that involves multiple services being sent to the module. This section has four parts. Each input module requires attention be paid to specific calibration ranges.

Table 11.2 lists the catalog numbers covered in this section:

**Table 11.2**

| For information about: | See page: |
|---|---|
| Calibrating the 1756-IF16 or 1756-IF8 Modules | 11-4 |
| Calibrating the 1756-IF6CIS or 1756-IF6I Modules | 11-9 |
| Calibrating the 1756-IR6I | 11-14 |
| Calibrating the 1756-IT6I or 1756-IT6I2 | 11-18 |

### Calibrating the 1756-IF16 or 1756-IF8 Modules

The 1756-IF16 or 1756-IF8 modules are used in applications requiring voltage or current. The modules offer 4 input ranges:

- -10 to 10V
- 0 to 5V
- 0 to 10V
- 0 to 20mA

However, you can only calibrate the modules using a voltage signal.

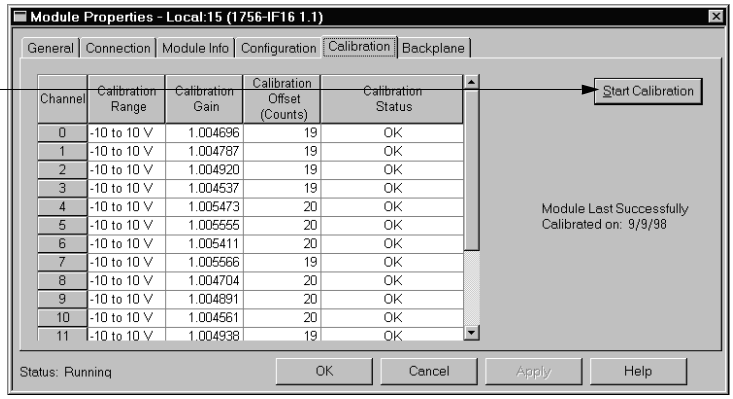
**IMPORTANT** Regardless of what application range is selected prior to calibration, all calibration uses a +/-10V range.

While you are online, you must access the modules' properties page. To see how to reach this page, see page 10-17.

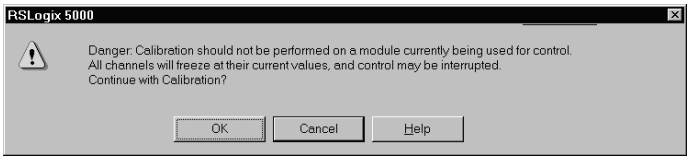
Follow these steps:

1. Connect your voltage calibrator to the module.
2. Go to the Calibration page. (Click on the tab for this page.)

Click here to start calibration


Module Properties - Local:15 (1756-IF16 1.1)
General
Connection
Module Info
Configuration
Calibration
Backplane
Channel
Calibration Range
Calibration Gain
Calibration Offset (Counts)
Calibration Status
0 -10 to 10 V 1.004696 19 OK
1 -10 to 10 V 1.004787 19 OK
2 -10 to 10 V 1.004920 19 OK
3 -10 to 10 V 1.004537 19 OK
4 -10 to 10 V 1.005473 20 OK
5 -10 to 10 V 1.005555 20 OK
6 -10 to 10 V 1.005411 20 OK
7 -10 to 10 V 1.005566 19 OK
8 -10 to 10 V 1.004704 20 OK
9 -10 to 10 V 1.004891 20 OK
10 -10 to 10 V 1.004561 20 OK
11 -10 to 10 V 1.004938 19 OK
Start Calibration
Module Last Successfully Calibrated on: 9/9/98
Status: Running
OK
Cancel
Apply
Help

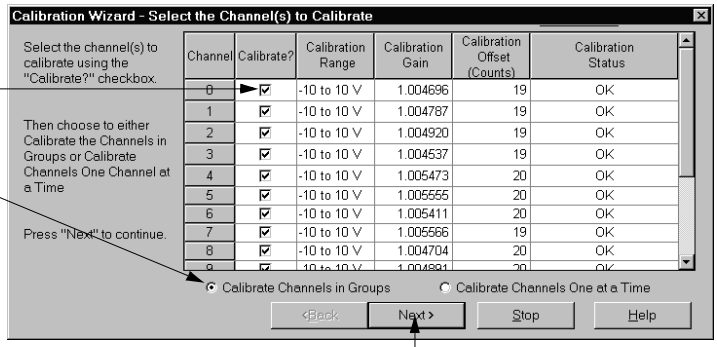
If your module is not in Program Mode, you see this warning. You must manually change the module to program mode before clicking on Yes.


RSLogix 5000
Danger: Calibration should not be performed on a module currently being used for control.
All channels will freeze at their current values, and control may be interrupted.
Continue with Calibration?
OK
Cancel
Help

**3.** Set the channels to be calibrated.

**A.** Choose the channels you want to calibrate here

**B.** Choose whether you want to calibrate channels in groups or one at a time here

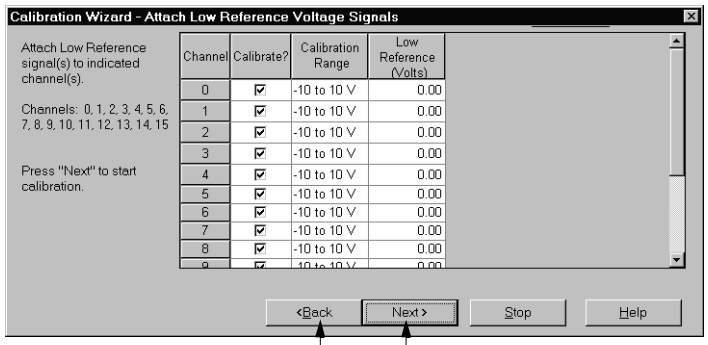

Calibration Wizard - Select the Channel(s) to Calibrate
Select the channel(s) to calibrate using the "Calibrate?" checkbox.
Then choose to either Calibrate the Channels in Groups or Calibrate Channels One Channel at a Time
Press "Next" to continue.
Channel
Calibrate?
Calibration Range
Calibration Gain
Calibration Offset (Counts)
Calibration Status
0 -10 to 10 V 1.004696 19 OK
1 -10 to 10 V 1.004787 19 OK
2 -10 to 10 V 1.004920 19 OK
3 -10 to 10 V 1.004537 19 OK
4 -10 to 10 V 1.005473 20 OK
5 -10 to 10 V 1.005555 20 OK
6 -10 to 10 V 1.005411 20 OK
7 -10 to 10 V 1.005566 19 OK
8 -10 to 10 V 1.004704 20 OK
Calibrate Channels in Groups
Calibrate Channels One at a Time
<Back
Next>
Stop
Help

**C.** Click here to continue

The low reference screen appears first.

This screen shows which channels will be calibrated for a low reference and the range of that calibration.

It also shows what reference signal is expected on the input.

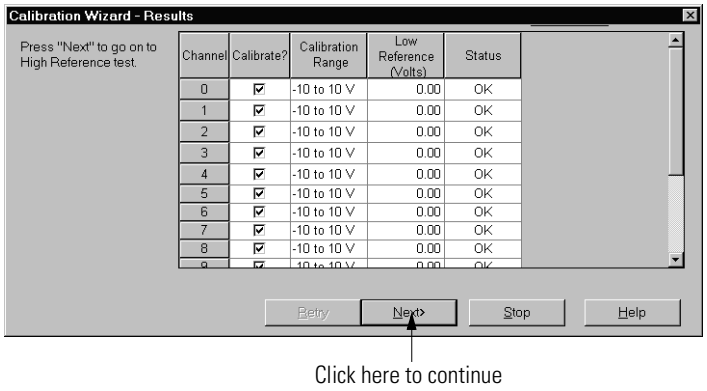

Calibration Wizard - Attach Low Reference Voltage Signals
Attach Low Reference signal(s) to indicated channel(s).
Channels: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15
Press "Next" to start calibration.
Channel
Calibrate?
Calibration Range
Low Reference (Volts)
0 -10 to 10 V 0.00
1 -10 to 10 V 0.00
2 -10 to 10 V 0.00
3 -10 to 10 V 0.00
4 -10 to 10 V 0.00
5 -10 to 10 V 0.00
6 -10 to 10 V 0.00
7 -10 to 10 V 0.00
8 -10 to 10 V 0.00
<Back
Next>
Stop
Help

Click here to return to the last screen and make any necessary changes

Click here to calibrate the low reference

**4.** Set the calibrator for the low reference and apply it to the module.

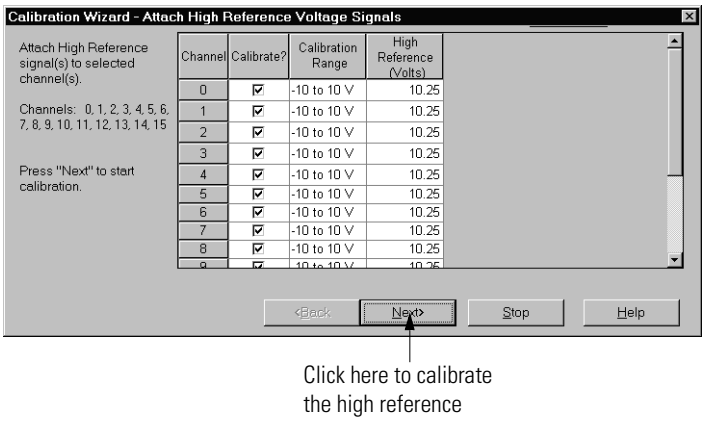
This screen displays the status of each channel after calibrating for a low reference. If all channels are OK, continue, as shown below. If any channels report an Error, retry step 4 until the status is OK.


Calibration Wizard - Results
Press "Next" to go on to High Reference test.
Channel
Calibrate?
Calibration Range
Low Reference (Volts)
Status
0 -10 to 10 V 0.00 OK
1 -10 to 10 V 0.00 OK
2 -10 to 10 V 0.00 OK
3 -10 to 10 V 0.00 OK
4 -10 to 10 V 0.00 OK
5 -10 to 10 V 0.00 OK
6 -10 to 10 V 0.00 OK
7 -10 to 10 V 0.00 OK
8 -10 to 10 V 0.00 OK
Retry
Next>
Stop
Help
Click here to continue

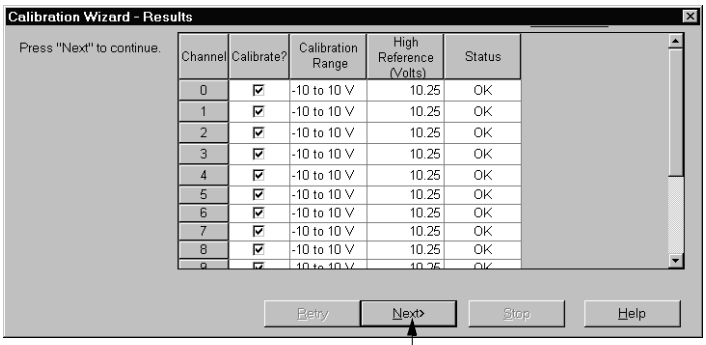
**5.** Set the calibrator for the high reference and apply it to the module.

This screen shows which channels will be calibrated for a high reference and the range of that calibration.

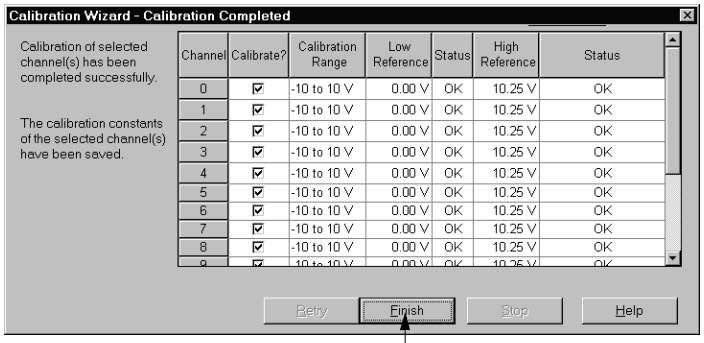
It also shows what reference signal is expected at the input.


Calibration Wizard - Attach High Reference Voltage Signals
Attach High Reference signal(s) to selected channel(s).
Channels: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15
Press "Next" to start calibration.
Channel
Calibrate?
Calibration Range
High Reference (Volts)
0 -10 to 10 V 10.25
1 -10 to 10 V 10.25
2 -10 to 10 V 10.25
3 -10 to 10 V 10.25
4 -10 to 10 V 10.25
5 -10 to 10 V 10.25
6 -10 to 10 V 10.25
7 -10 to 10 V 10.25
8 -10 to 10 V 10.25
<Back
Next>
Stop
Help
Click here to calibrate the high reference

This screen displays the status of each channel after calibrating for a high reference. If all channels are OK, continue, as shown below. If any channels report an Error, retry step 5 until the status is OK.


Calibration Wizard - Results
Press "Next" to continue.
Channel
Calibrate?
Calibration Range
High Reference (Volts)
Status
0 -10 to 10 V 10.25 OK
1 -10 to 10 V 10.25 OK
2 -10 to 10 V 10.25 OK
3 -10 to 10 V 10.25 OK
4 -10 to 10 V 10.25 OK
5 -10 to 10 V 10.25 OK
6 -10 to 10 V 10.25 OK
7 -10 to 10 V 10.25 OK
8 -10 to 10 V 10.25 OK
Retry
Next>
Stop
Help
Click here to continue

After you have completed both low and high reference calibration, this screen shows the status of both.


Calibration Wizard - Calibration Completed
Calibration of selected channel(s) has been completed successfully.
The calibration constants of the selected channel(s) have been saved.
Channel
Calibrate?
Calibration Range
Low Reference
Status
High Reference
Status
0 -10 to 10 V 0.00 V OK 10.25 V OK
1 -10 to 10 V 0.00 V OK 10.25 V OK
2 -10 to 10 V 0.00 V OK 10.25 V OK
3 -10 to 10 V 0.00 V OK 10.25 V OK
4 -10 to 10 V 0.00 V OK 10.25 V OK
5 -10 to 10 V 0.00 V OK 10.25 V OK
6 -10 to 10 V 0.00 V OK 10.25 V OK
7 -10 to 10 V 0.00 V OK 10.25 V OK
8 -10 to 10 V 0.00 V OK 10.25 V OK
Retry
Finish
Stop
Help
Click here to return the module to normal operation

## Calibrating the 1756-IF6CIS or 1756-IF6I Modules

The 1756-IF6CIS module can be used for applications that require current only. The 1756-IF6I module can be used for applications requiring voltage or current. Calibrate the modules for your specific application.

### *Calibrating the 1756-IF6I for Voltage Applications*

During 1756-IF6I module calibration, 0.0V and +10.0V external references are applied consecutively to the module's terminals. The module records the deviation from these reference values (i.e. 0.0V and +10.0V) and stores it as calibration constants in the module's firmware. The internal calibration constants are then used in every subsequent signal conversion to compensate for circuit inaccuracies. The 0/10V user calibration compensates for all voltage ranges on the 1756-IF6I module (0-10V, +/-10V, and 0-5V) and compensates for inaccuracies of the module's entire analog circuitry, including input amplifier, resistors, and the A/D convertor.

The 1756-IF6I offers 3 input voltage ranges:

- -10 to 10V
- 0 to 5V
- 0 to 10V

**IMPORTANT** Regardless of what voltage application range is selected prior to calibration, all voltage calibration uses a +/-10V range.

### *Calibrating the 1756-IF6CIS or 1756-IF6I for Current Applications*

The 1756-IF6CIS and 1756-IF6I modules offer a 0 to 20mA current range. Calibrating the modules for current uses the same process as calibrating the 1756-IF6I for voltage except the change in input signal.

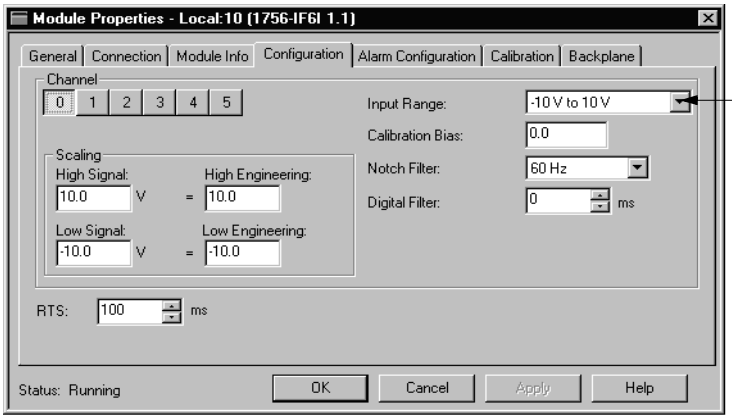
**IMPORTANT** The following example shows how you can calibrate the 1756-IF6I module for voltage.

While you are online, you must access the modules' properties page. To see how to reach this page, see page 10-17.

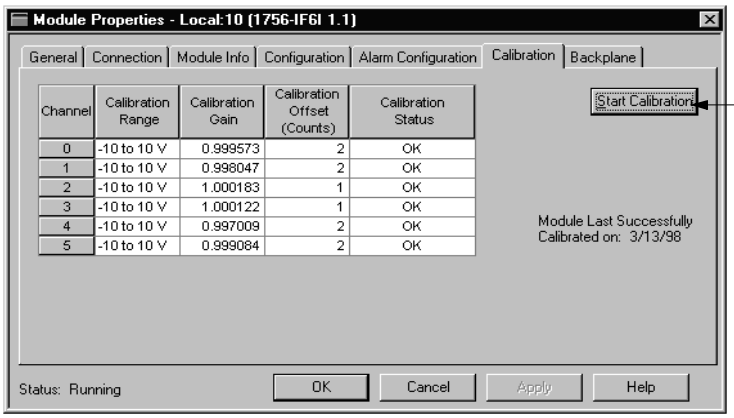
Follow these steps:

1. Connect your voltage calibrator to the module.
2. Go to the Configuration page.

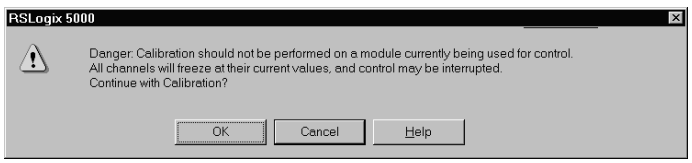
**IMPORTANT**: Make sure you choose the correct input range for each channel to be calibrated.



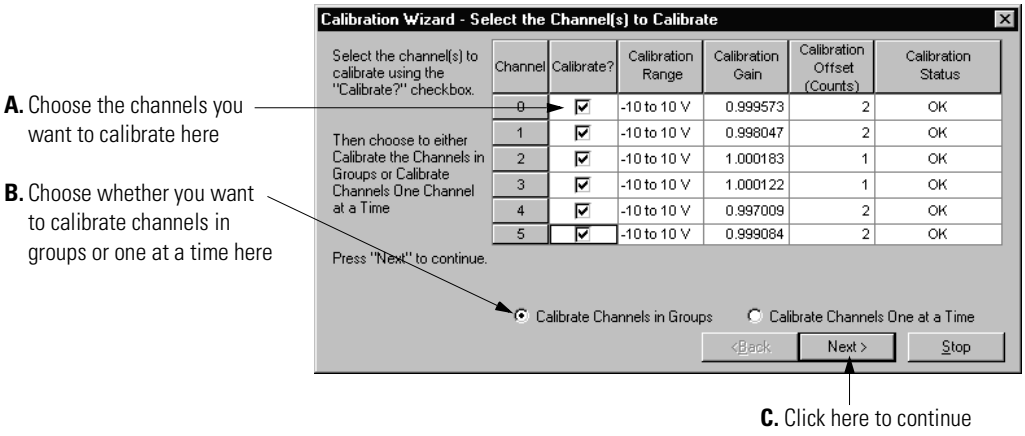

3. Go to the Calibration page. (Click on the tab for this page.)




If your module is not in Program Mode, you see this warning. You must manually change the module to program mode before clicking on Yes.

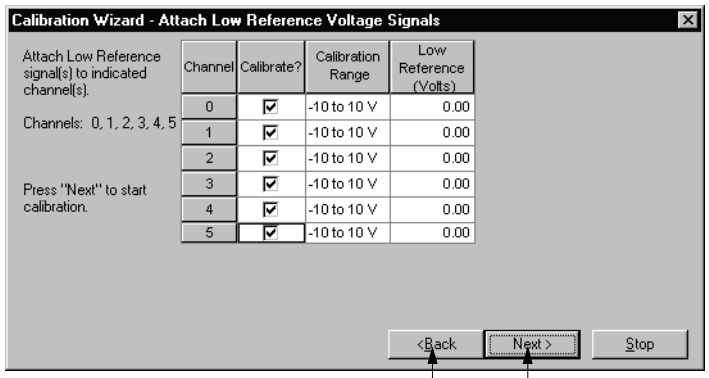

RSLogix 5000
Danger: Calibration should not be performed on a module currently being used for control.
All channels will freeze at their current values, and control may be interrupted.
Continue with Calibration?
OK
Cancel
Help

**4.** Set the channels to be calibrated.

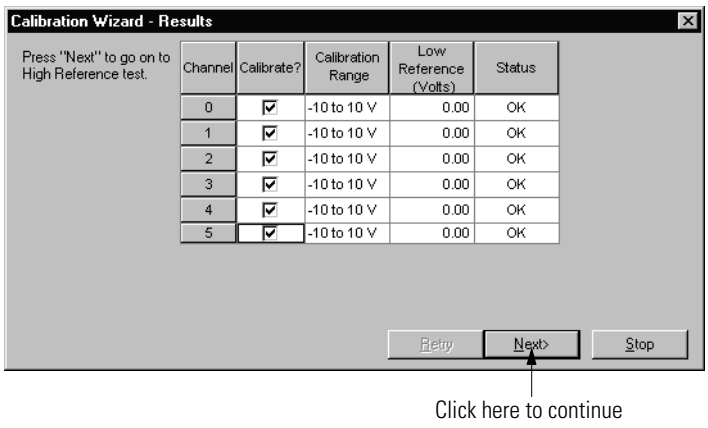

Calibration Wizard - Select the Channel(s) to Calibrate
Select the channel(s) to calibrate using the "Calibrate?" checkbox.
Then choose to either Calibrate the Channels in Groups or Calibrate Channels One Channel at a Time
Press "Next" to continue.
Channel
Calibrate?
Calibration Range
Calibration Gain
Calibration Offset (Counts)
Calibration Status
0 -10 to 10 V 0.999573 2 OK
1 -10 to 10 V 0.998047 2 OK
2 -10 to 10 V 1.000183 1 OK
3 -10 to 10 V 1.000122 1 OK
4 -10 to 10 V 0.997009 2 OK
5 -10 to 10 V 0.999084 2 OK
Calibrate Channels in Groups
Calibrate Channels One at a Time
<Back
Next >
Stop
A. Choose the channels you want to calibrate here
B. Choose whether you want to calibrate channels in groups or one at a time here
C. Click here to continue

The low reference screen appears first.

**5.** Set the calibrator for the low reference and apply it to the module.

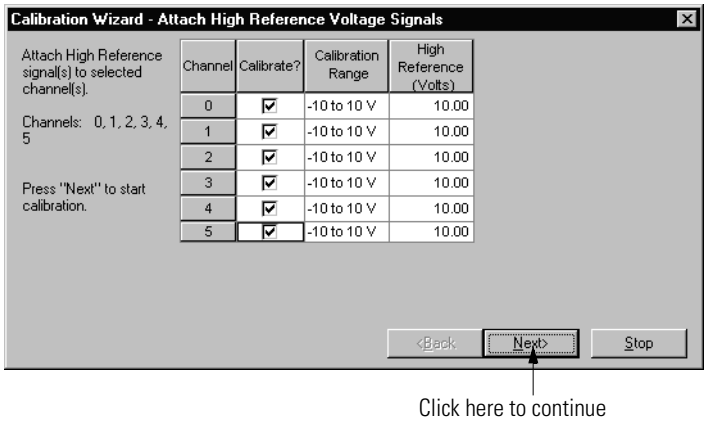

Calibration Wizard - Attach Low Reference Voltage Signals
Attach Low Reference signal(s) to indicated channel(s).
Channels: 0, 1, 2, 3, 4, 5
Press "Next" to start calibration.
Channel
Calibrate?
Calibration Range
Low Reference (Volts)
0 -10 to 10 V 0.00
1 -10 to 10 V 0.00
2 -10 to 10 V 0.00
3 -10 to 10 V 0.00
4 -10 to 10 V 0.00
5 -10 to 10 V 0.00
<Back
Next >
Stop
This screen shows which channels will be calibrated for a low reference and the range of that calibration.
It also shows what reference signal is expected on the input.
Click here to return to the last screen and make any necessary changes
Click here to calibrate the low reference

This screen displays the status of each channel after calibrating for a low reference. If all channels are OK, continue, as shown below. If any channels report an Error, retry step 5 until the status is OK.


Calibration Wizard - Results
Press "Next" to go on to High Reference test.
Channel
Calibrate?
Calibration Range
Low Reference (Volts)
Status
0 -10 to 10 V 0.00 OK
1 -10 to 10 V 0.00 OK
2 -10 to 10 V 0.00 OK
3 -10 to 10 V 0.00 OK
4 -10 to 10 V 0.00 OK
5 -10 to 10 V 0.00 OK
Retry
Next>
Stop
Click here to continue

Now you must calibrate each channel for a high reference voltage.

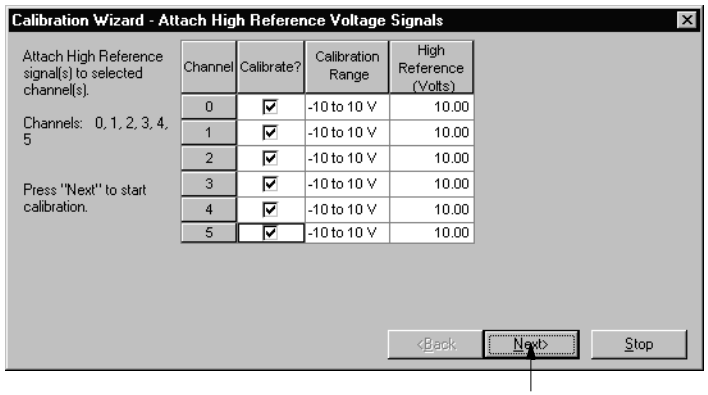
**6.** Set the channels to be calibrated.


Calibration Wizard - Attach High Reference Voltage Signals
Attach High Reference signal(s) to selected channel(s).
Channels: 0, 1, 2, 3, 4, 5
Press "Next" to start calibration.
Channel
Calibrate?
Calibration Range
High Reference (Volts)
0 -10 to 10 V 10.00
1 -10 to 10 V 10.00
2 -10 to 10 V 10.00
3 -10 to 10 V 10.00
4 -10 to 10 V 10.00
5 -10 to 10 V 10.00
<Back
Next>
Stop
Click here to continue

**7.** Set the calibrator for the high reference and apply it to the module.

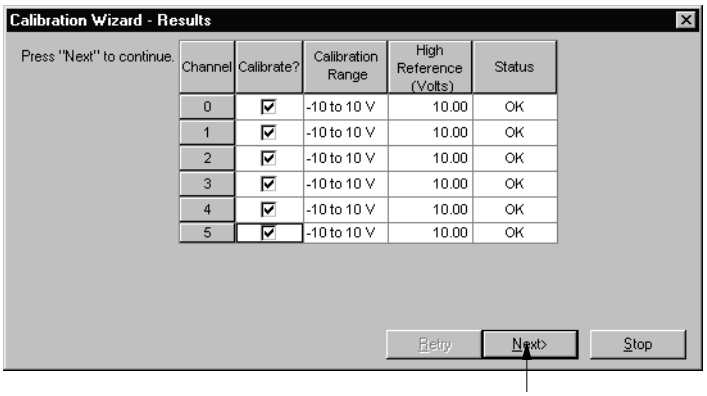
This screen shows which channels will be calibrated for a high reference and the range of that calibration.

It also shows what reference signal is expected at the input.


Calibration Wizard - Attach High Reference Voltage Signals
Attach High Reference signal(s) to selected channel(s).
Channels: 0, 1, 2, 3, 4, 5
Press "Next" to start calibration.
Channel
Calibrate?
Calibration Range
High Reference (Volts)
0 -10 to 10 V 10.00
1 -10 to 10 V 10.00
2 -10 to 10 V 10.00
3 -10 to 10 V 10.00
4 -10 to 10 V 10.00
5 -10 to 10 V 10.00
<Back
Next>
Stop

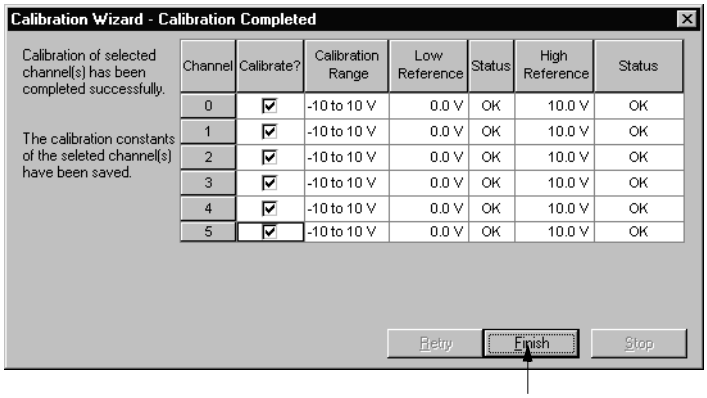
Click here to calibrate the high reference

This screen displays the status of each channel after calibrating for a high reference. If all channels are OK, continue, as shown below. If any channels report an Error, retry step 7 until the status is OK.




Click here to continue

After you have completed both low and high reference calibration, this screen shows the status of both.


Calibration Wizard - Calibration Completed
Calibration of selected channel(s) has been completed successfully.
The calibration constants of the seleted channel(s) have been saved.
Channel
Calibrate?
Calibration Range
Low Reference
Status
High Reference
Status
0 -10 to 10 V 0.0 V OK 10.0 V OK
1 -10 to 10 V 0.0 V OK 10.0 V OK
2 -10 to 10 V 0.0 V OK 10.0 V OK
3 -10 to 10 V 0.0 V OK 10.0 V OK
4 -10 to 10 V 0.0 V OK 10.0 V OK
5 -10 to 10 V 0.0 V OK 10.0 V OK
Retry
Finish
Stop

Click here to finish calibration and return the module to normal operation

## Calibrating the 1756-IR6I

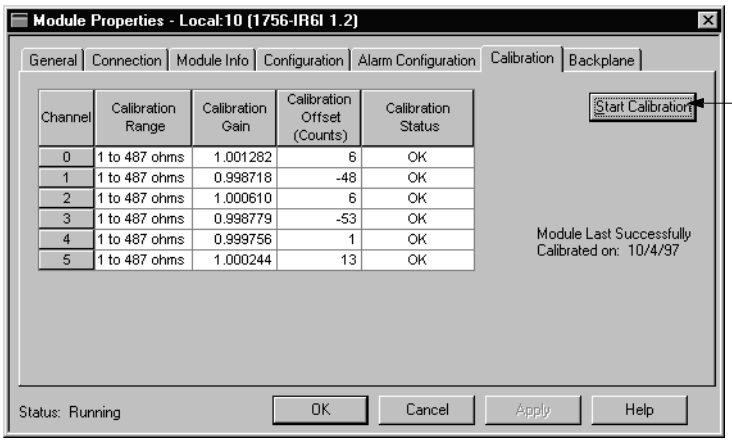
This module does not calibrate for voltage or current. It uses two precision resistors to calibrate the channels in ohms. You must connect a 1Ω precision resistor for low reference calibration and a 487Ω precision resistor for high reference calibration. The 1756-IR6I only calibrates in the 1-487Ω range.

**IMPORTANT** When you are wiring precision resistors for calibration, follow the wiring example on page 6-20. Make sure terminals IN-x/B and RTN-x/C are shorted together at the RTB.

While you are online, you must access the modules' properties page. To see how to reach this page, see page 10-17.

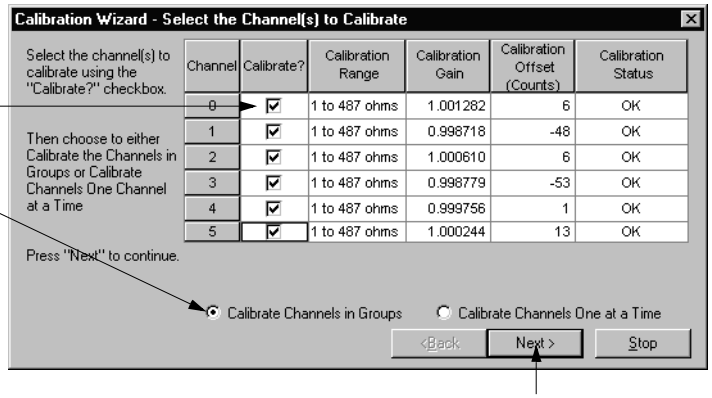
Follow these steps:

1. Go to the Calibration page. (Click on the tab for this page.)




**IMPORTANT** Regardless of what ohms application range is selected prior to calibration, the 1756-IR6I only calibrates in the 1-487Ω range.

**2.** Set the channels to be calibrated.


Calibration Wizard - Select the Channel(s) to Calibrate
Select the channel(s) to calibrate using the "Calibrate?" checkbox.
Then choose to either Calibrate the Channels in Groups or Calibrate Channels One Channel at a Time
Press "Next" to continue.
Channel
Calibrate?
Calibration Range
Calibration Gain
Calibration Offset (Counts)
Calibration Status
0 1 to 487 ohms 1.001282 6 OK
1 1 to 487 ohms 0.998718 -48 OK
2 1 to 487 ohms 1.000610 6 OK
3 1 to 487 ohms 0.998779 -53 OK
4 1 to 487 ohms 0.999756 1 OK
5 1 to 487 ohms 1.000244 13 OK
Calibrate Channels in Groups
Calibrate Channels One at a Time
<Back
Next >
Stop

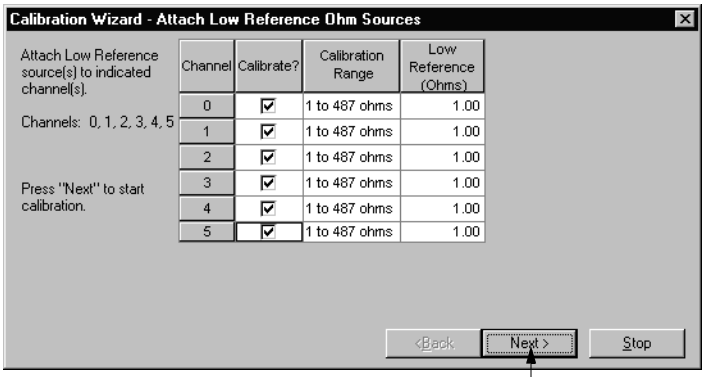
**A.** Choose the channels you want to calibrate here

**B.** Choose whether you want to calibrate channels in groups or one at a time here

**C.** Click here to continue

The low reference screen appears first.

**3.** Connect a 1Ω resistor to each channel being calibrated.

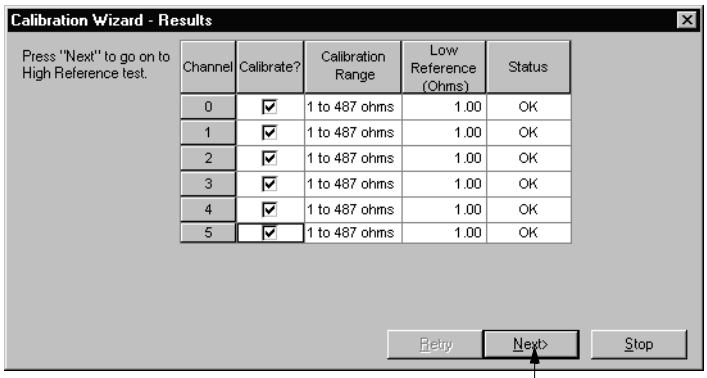

Calibration Wizard - Attach Low Reference Ohm Sources
Attach Low Reference source(s) to indicated channel(s).
Channels: 0, 1, 2, 3, 4, 5
Press "Next" to start calibration.
Channel
Calibrate?
Calibration Range
Low Reference (Ohms)
0 1 to 487 ohms 1.00
1 1 to 487 ohms 1.00
2 1 to 487 ohms 1.00
3 1 to 487 ohms 1.00
4 1 to 487 ohms 1.00
5 1 to 487 ohms 1.00
<Back
Next >
Stop

This screen shows which channels will be calibrated for a low reference and the range of that calibration.

It also shows what reference signal is expected on the input.

Click here to calibrate the low reference

This screen displays the status of each channel after calibrating for a low reference. If all channels are OK, continue, as shown below. If any channels report an Error, retry step 3 until the status is OK.


Calibration Wizard - Results
Press "Next" to go on to High Reference test.
Channel
Calibrate?
Calibration Range
Low Reference (Ohms)
Status
0 1 to 487 ohms 1.00 OK
1 1 to 487 ohms 1.00 OK
2 1 to 487 ohms 1.00 OK
3 1 to 487 ohms 1.00 OK
4 1 to 487 ohms 1.00 OK
5 1 to 487 ohms 1.00 OK
Retry
Next>
Stop

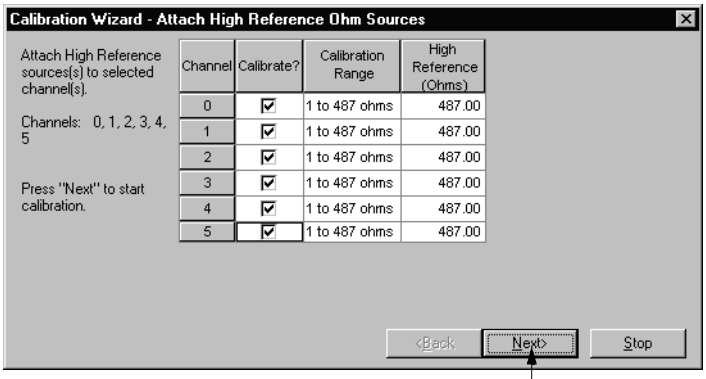
Click here to continue

Now you must calibrate each channel for a high reference.

**4.** Connect a 487Ω resistor to each channel being calibrated.

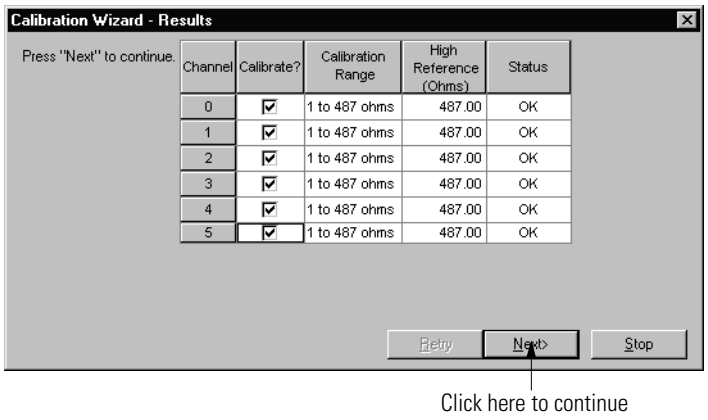
This screen shows which channels will be calibrated for a high reference and the range of that calibration.

It also shows what reference signal is expected on the input.

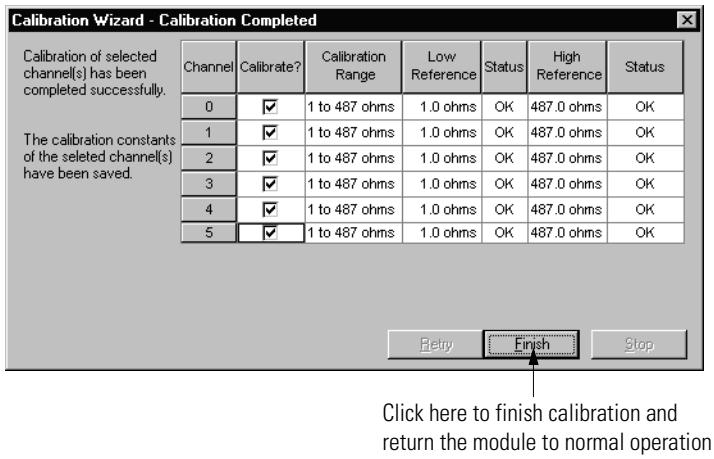

Calibration Wizard - Attach High Reference Ohm Sources
Attach High Reference sources(s) to selected channel(s).
Channels: 0, 1, 2, 3, 4, 5
Press "Next" to start calibration.
Channel
Calibrate?
Calibration Range
High Reference (Ohms)
0 1 to 487 ohms 487.00
1 1 to 487 ohms 487.00
2 1 to 487 ohms 487.00
3 1 to 487 ohms 487.00
4 1 to 487 ohms 487.00
5 1 to 487 ohms 487.00
<Back
Next>
Stop

Click here to calibrate the high reference

This screen displays the status of each channel after calibrating for a high reference. If all channels are OK, continue, as shown below. If any channels report an Error, retry step 4 until the status is OK.




After you have completed both low and high reference calibration, this screen shows the status of both and allows you to finish the calibration process and return to normal operation.


Calibration Wizard - Calibration Completed
Calibration of selected channel(s) has been completed successfully.
The calibration constants of the seleted channel(s) have been saved.
Channel
Calibrate?
Calibration Range
Low Reference
Status
High Reference
Status
0 1 to 487 ohms 1.0 ohms OK 487.0 ohms OK
1 1 to 487 ohms 1.0 ohms OK 487.0 ohms OK
2 1 to 487 ohms 1.0 ohms OK 487.0 ohms OK
3 1 to 487 ohms 1.0 ohms OK 487.0 ohms OK
4 1 to 487 ohms 1.0 ohms OK 487.0 ohms OK
5 1 to 487 ohms 1.0 ohms OK 487.0 ohms OK
Retry
Finish
Stop
Click here to finish calibration and return the module to normal operation

## Calibrating the 1756-IT6I or 1756-IT6I2

This module only calibrates in millivolts. You can calibrate the module to either a -12 to +30mV range or -12 to +78mV range, depending upon your specific application.

*Calibrating the 1756-IT6I or 1756-IT6I2 for a -12mV to 30mV Range*

This example shows the steps for calibrating a 1756-IT6I module for a -12mV to 30mV range. Use the same steps to calibrate for a -12mV to 78mV range.

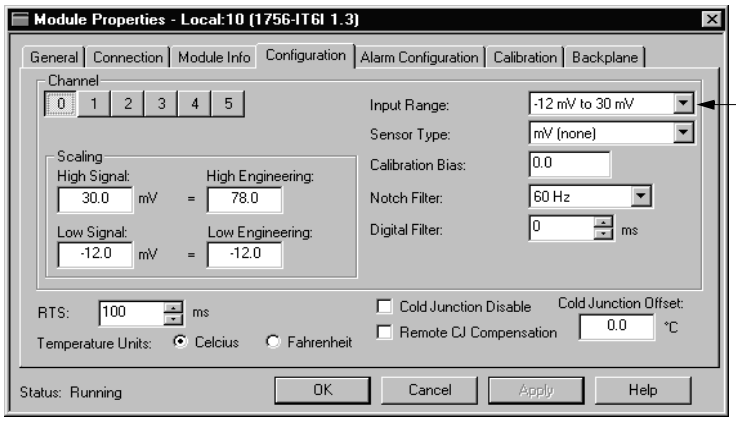
While you are online, you must access the modules' properties page. To see how to reach this page, see page 10-17.

Follow these steps:

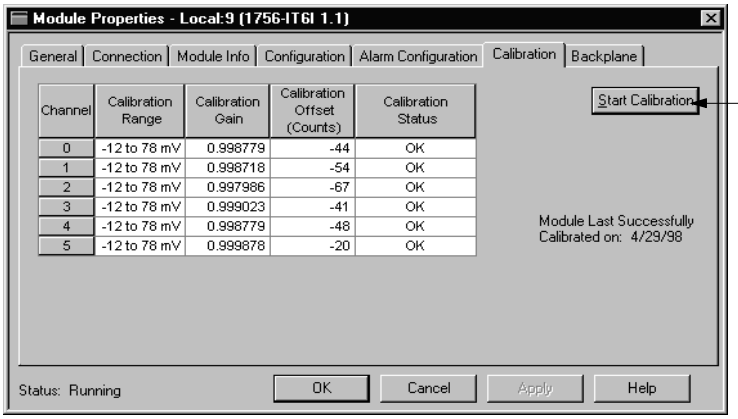
1. Connect your voltage calibrator to the module.

2. Go to the Configuration page.

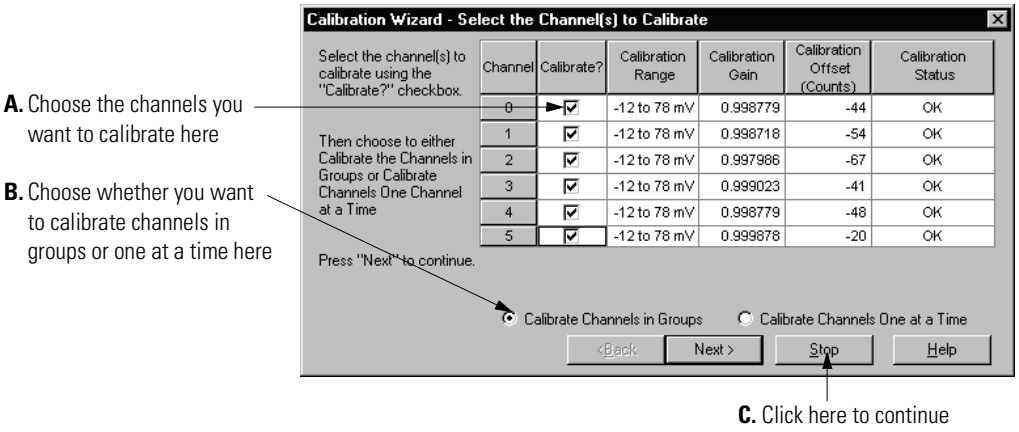
**IMPORTANT**: The input range selected prior to calibration is the range in which the module will calibrate.




3. Go to the Calibration page. (Click on the tab for this page.)

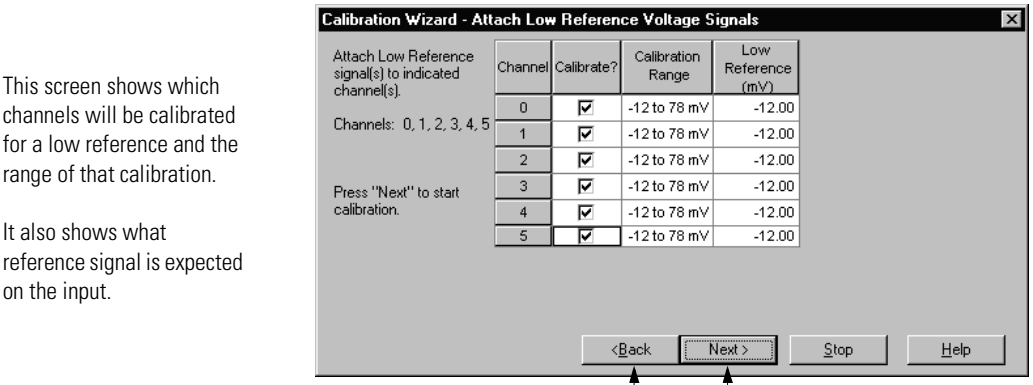


**4.** Set the channels to be calibrated.

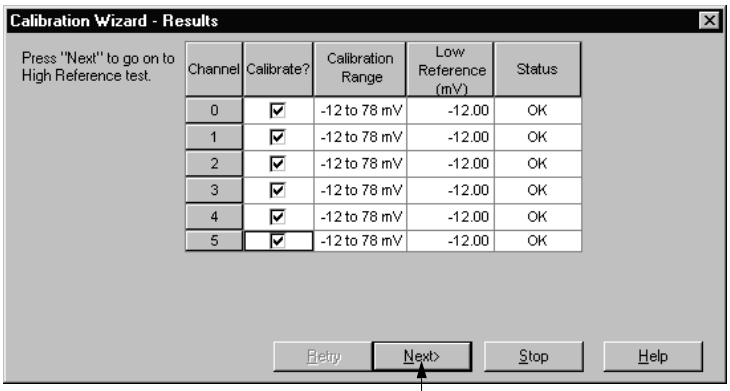

Calibration Wizard - Select the Channel(s) to Calibrate
Select the channel(s) to calibrate using the "Calibrate?" checkbox.
Then choose to either Calibrate the Channels in Groups or Calibrate Channels One Channel at a Time
Press "Next" to continue.
Channel
Calibrate?
Calibration Range
Calibration Gain
Calibration Offset (Counts)
Calibration Status
0 -12 to 78 mV 0.998779 -44 OK
1 -12 to 78 mV 0.998718 -54 OK
2 -12 to 78 mV 0.997986 -67 OK
3 -12 to 78 mV 0.999023 -41 OK
4 -12 to 78 mV 0.998779 -48 OK
5 -12 to 78 mV 0.999878 -20 OK
Calibrate Channels in Groups
Calibrate Channels One at a Time
<Back
Next >
Stop
Help
A. Choose the channels you want to calibrate here
B. Choose whether you want to calibrate channels in groups or one at a time here
C. Click here to continue

The low reference screen appears first.

**5.** Set the calibrator for the low reference and apply it to the module.


Calibration Wizard - Attach Low Reference Voltage Signals
Attach Low Reference signal(s) to indicated channel(s).
Channels: 0, 1, 2, 3, 4, 5
Press "Next" to start calibration.
Channel
Calibrate?
Calibration Range
Low Reference (mV)
0 -12 to 78 mV -12.00
1 -12 to 78 mV -12.00
2 -12 to 78 mV -12.00
3 -12 to 78 mV -12.00
4 -12 to 78 mV -12.00
5 -12 to 78 mV -12.00
<Back
Next >
Stop
Help
This screen shows which channels will be calibrated for a low reference and the range of that calibration.
It also shows what reference signal is expected on the input.
Click here to return to the last screen and make any necessary changes
Click here to calibrate the low reference

This screen displays the status of each channel after calibrating for a low reference. If all channels are OK, continue, as shown below. If any channels report an Error, retry step 5 until the status is OK.

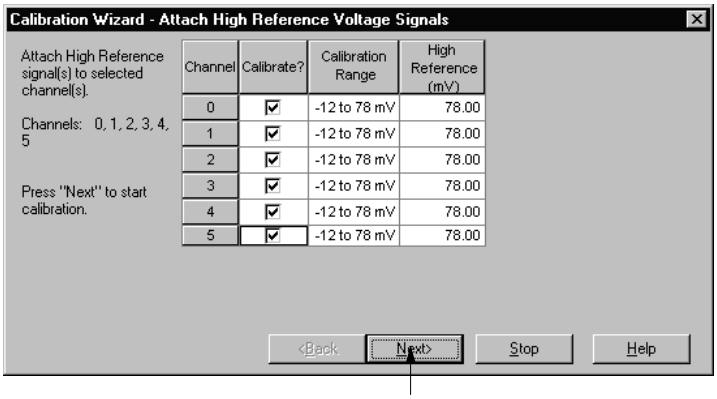

Calibration Wizard - Results
Press "Next" to go on to High Reference test.
Channel
Calibrate?
Calibration Range
Low Reference (mV)
Status
0 -12 to 78 mV -12.00 OK
1 -12 to 78 mV -12.00 OK
2 -12 to 78 mV -12.00 OK
3 -12 to 78 mV -12.00 OK
4 -12 to 78 mV -12.00 OK
5 -12 to 78 mV -12.00 OK
Retry
Next>
Stop
Help
Click here to calibrate the high reference

Now you must calibrate each channel for a high reference voltage.

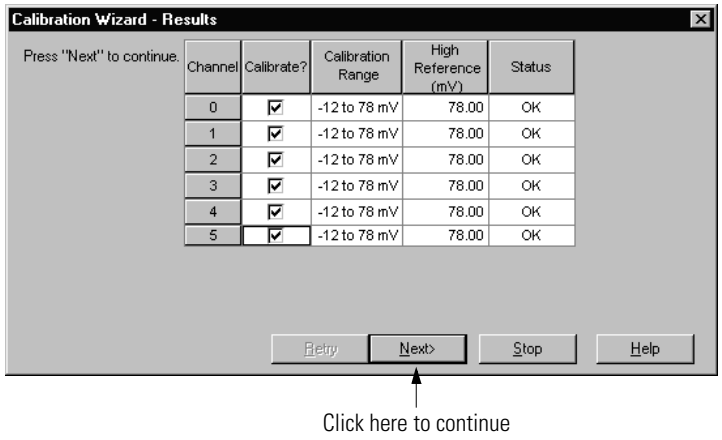
**6.** Set the calibrator for the high reference and apply it to the module.

This screen shows which channels will be calibrated for a high reference and the range of that calibration.

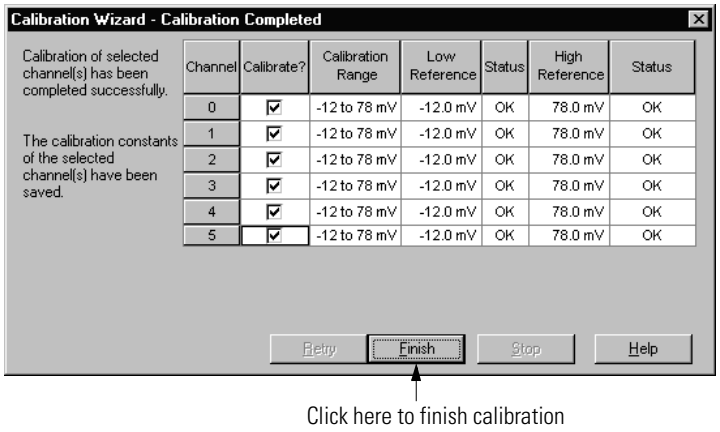
It also shows what reference signal is expected on the input.


Calibration Wizard - Attach High Reference Voltage Signals
Attach High Reference signal(s) to selected channel(s).
Channels: 0, 1, 2, 3, 4, 5
Press "Next" to start calibration.
Channel
Calibrate?
Calibration Range
High Reference (mV)
0 -12 to 78 mV 78.00
1 -12 to 78 mV 78.00
2 -12 to 78 mV 78.00
3 -12 to 78 mV 78.00
4 -12 to 78 mV 78.00
5 -12 to 78 mV 78.00
<Back
Next>
Stop
Help
Click here to calibrate the high reference

This screen displays the status of each channel after calibrating for a high reference. If all channels are OK, continue, as shown below. If any channels report an Error, retry step 6 until the status is OK.




After you have completed both low and high reference calibration, this screen shows the status of both and allows you to finish the calibration process and return to normal operation.


Calibration Wizard - Calibration Completed
Calibration of selected channel(s) has been completed successfully.
The calibration constants of the selected channel(s) have been saved.
Channel
Calibrate?
Calibration Range
Low Reference
Status
High Reference
Status
0 -12 to 78 mV -12.0 mV OK 78.0 mV OK
1 -12 to 78 mV -12.0 mV OK 78.0 mV OK
2 -12 to 78 mV -12.0 mV OK 78.0 mV OK
3 -12 to 78 mV -12.0 mV OK 78.0 mV OK
4 -12 to 78 mV -12.0 mV OK 78.0 mV OK
5 -12 to 78 mV -12.0 mV OK 78.0 mV OK
Retry
Finish
Stop
Help
Click here to finish calibration

## Calibrating Output Modules

Output calibration is a multi-step process that involves measuring a signal from the module. This section has three parts.

Table 11.3 lists the catalog numbers covered in this section:

**Table 11.3**

| For information about: | See page: |
|---|---|
| Calibrating the 1756-OF4 or 1756-OF8 Modules | 11-22 |
| Calibrating the 1756-OF6CI | 11-27 |
| Calibrating the 1756-OF6VI | 11-31 |

### Calibrating the 1756-OF4 or 1756-OF8 Modules

The 1756-OF4 and 1756-OF8 modules can be used for current or voltage applications.

*Current applications*

RSLogix 5000 commands the module to output specific levels of current. You must measure the actual level and record the results. This measurement allows the module to account for any inaccuracies.

Click here to start calibration

*Voltage applications*

RSLogix 5000 commands the module to output specific levels of voltage. You must measure the actual level and record the results. This measurement allows the module to account for any inaccuracies.

**IMPORTANT** This example shows a module calibrated for a current application. Use the same steps to calibrate for voltage.

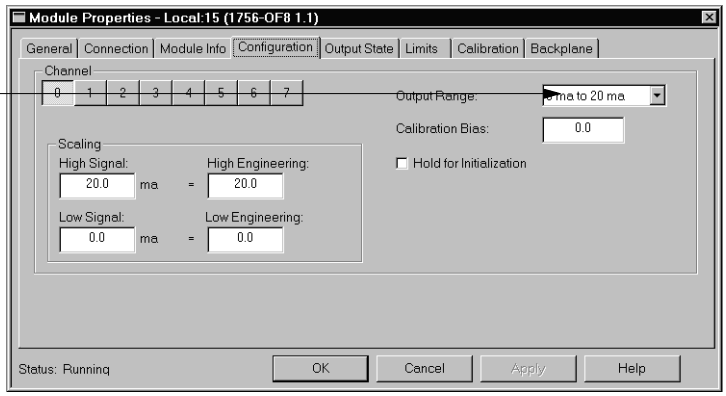
While you are online, you must access the modules' properties page. To see how to reach this page, see page 10-17.

Follow these steps:

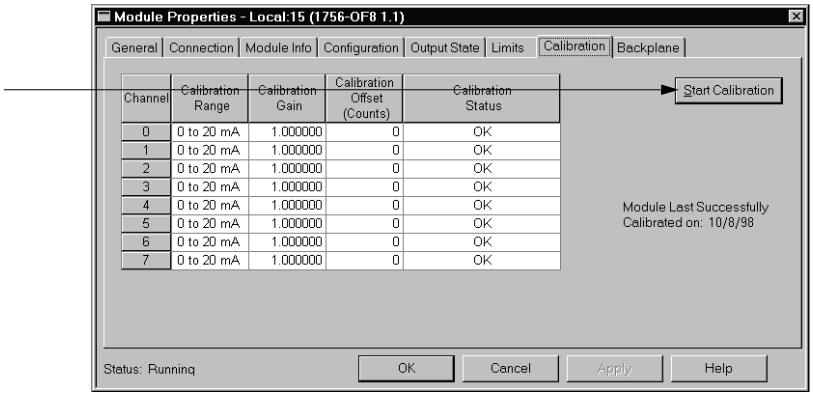
1. Connect your current meter to the module.

2. Go to the Configuration page. (Click on the tab for this page.)

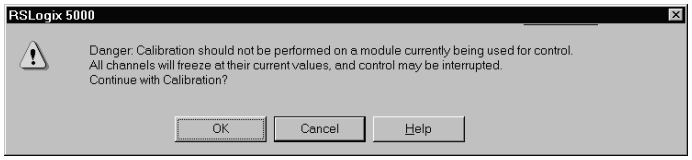
Use this pull-down menu to choose the Output Range to which you want to calibrate



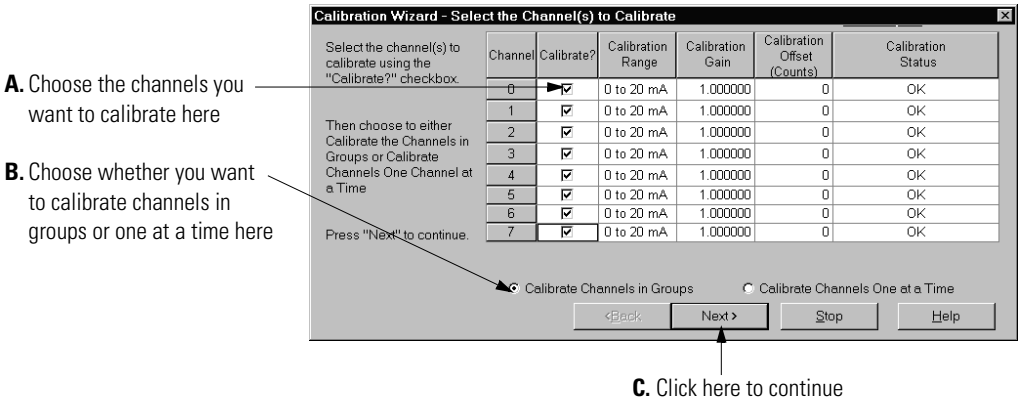

3. Go to the Calibration page. (Click on the tab for this page.)



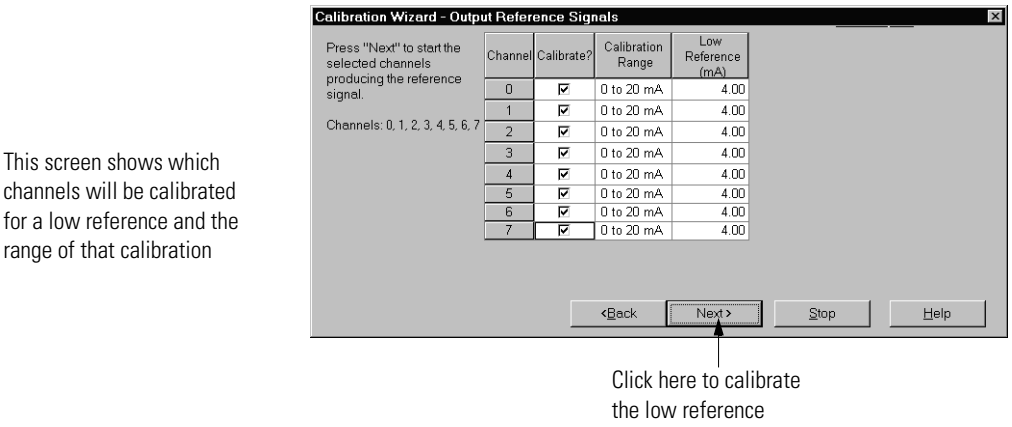

If your module is not in Program Mode, you see this warning. You must manually change the module to program mode before clicking on Yes.


RSLogix 5000
Danger: Calibration should not be performed on a module currently being used for control.
All channels will freeze at their current values, and control may be interrupted.
Continue with Calibration?
OK
Cancel
Help

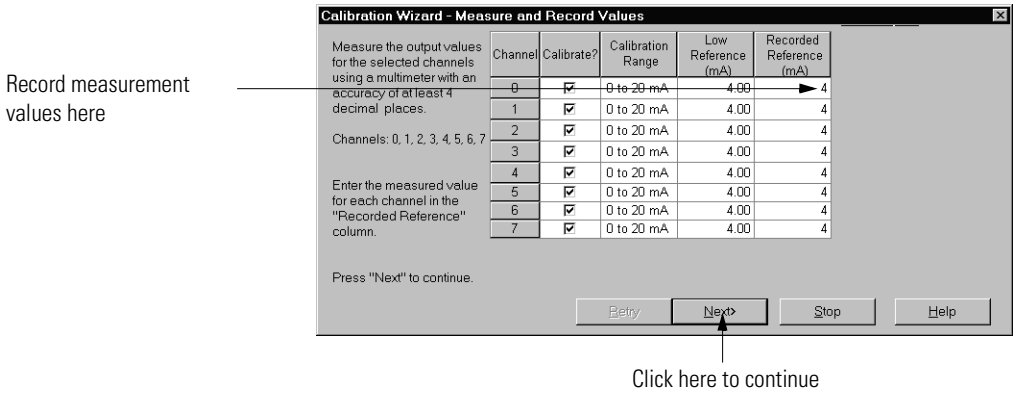
**4.** Set the channels to be calibrated.


Calibration Wizard - Select the Channel(s) to Calibrate
Select the channel(s) to calibrate using the "Calibrate?" checkbox.
Then choose to either Calibrate the Channels in Groups or Calibrate Channels One Channel at a Time
Press "Next" to continue.
Channel
Calibrate?
Calibration Range
Calibration Gain
Calibration Offset (Counts)
Calibration Status
0 to 20 mA
1.000000
OK
Calibrate Channels in Groups
Calibrate Channels One at a Time
<Back
Next >
Stop
Help
A. Choose the channels you want to calibrate here
B. Choose whether you want to calibrate channels in groups or one at a time here
C. Click here to continue

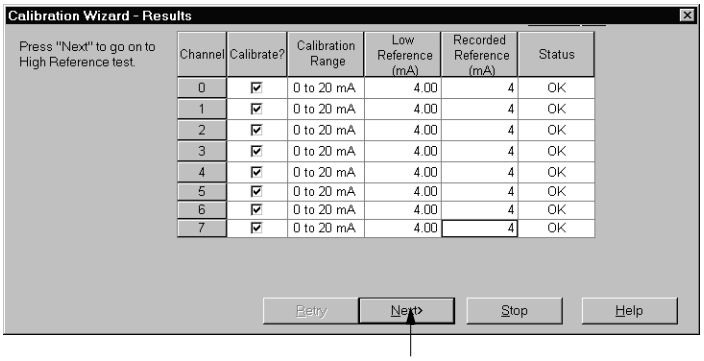
The low reference screen appears first.


Calibration Wizard - Output Reference Signals
Press "Next" to start the selected channels producing the reference signal.
Channels: 0, 1, 2, 3, 4, 5, 6, 7
Channel
Calibrate?
Calibration Range
Low Reference (mA)
0 to 20 mA
4.00
<Back
Next >
Stop
Help
This screen shows which channels will be calibrated for a low reference and the range of that calibration
Click here to calibrate the low reference

**5.** Record the results of your measurement.


Calibration Wizard - Measure and Record Values
Measure the output values for the selected channels using a multimeter with an accuracy of at least 4 decimal places.
Channels: 0, 1, 2, 3, 4, 5, 6, 7
Enter the measured value for each channel in the "Recorded Reference" column.
Press "Next" to continue.
Channel
Calibrate?
Calibration Range
Low Reference (mA)
Recorded Reference (mA)
0 to 20 mA
4.00
4
Retry
Next>
Stop
Help
Record measurement values here
Click here to continue

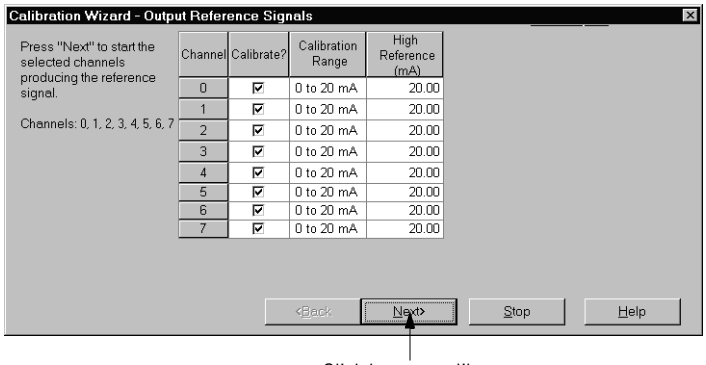
This screen displays the status of each channel after calibrating for a low reference. If all channels are OK, continue, as shown below. If any channels report an Error, return to step 4 until the status is OK.




Now you must calibrate each channel for a high reference voltage.

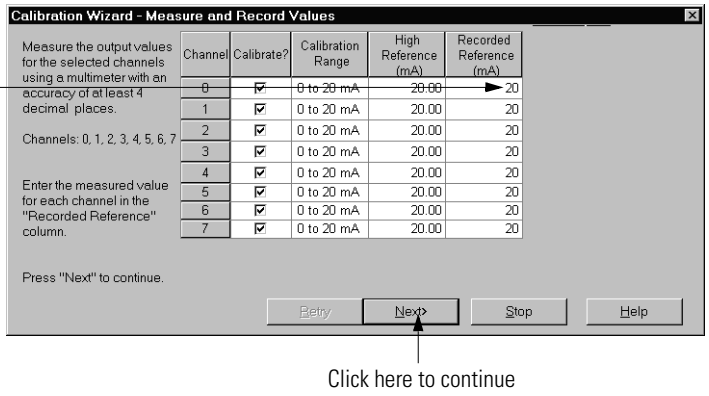
**6.** Set the channels to be calibrated.

This screen shows which channels will be calibrated for a high reference and the range of that calibration

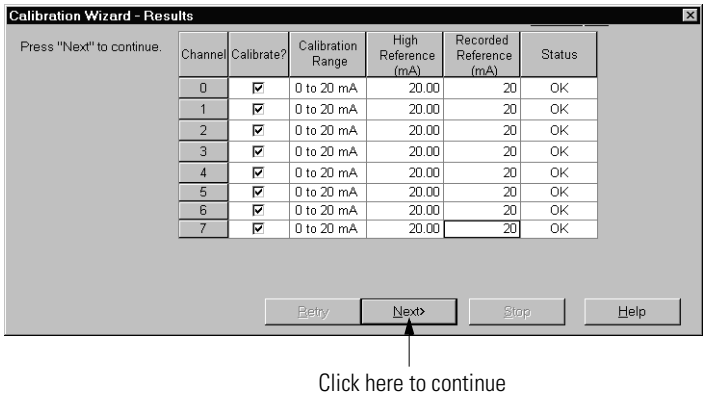



**7.** Record the measurement.

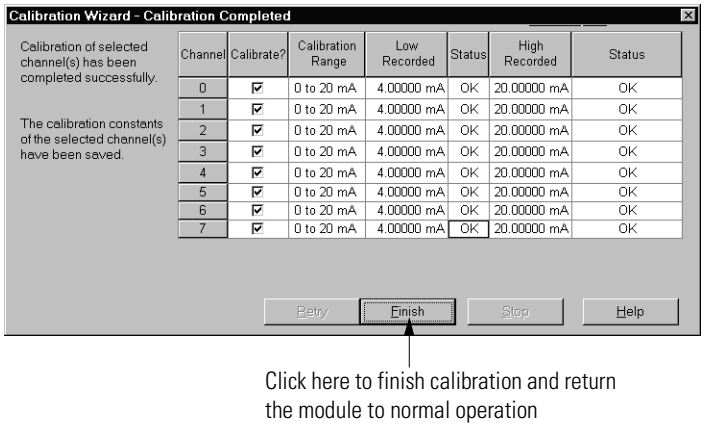
Record measurement values here


Calibration Wizard - Measure and Record Values
Measure the output values for the selected channels using a multimeter with an accuracy of at least 4 decimal places.
Channels: 0, 1, 2, 3, 4, 5, 6, 7
Enter the measured value for each channel in the "Recorded Reference" column.
Press "Next" to continue.
Channel
Calibrate?
Calibration Range
High Reference (mA)
Recorded Reference (mA)
0 to 20 mA
20.00
20
Retry
Next>
Stop
Help
Click here to continue

This screen displays the status of each channel after calibrating for a high reference. If all channels are OK, continue, as shown below. If any channels report an Error, return to step 6 until the status is OK.




After you have completed both low and high reference calibration, this screen shows the status of both and allows you to finish the calibration process and return to normal operation.



## Calibrating the 1756-OF6CI

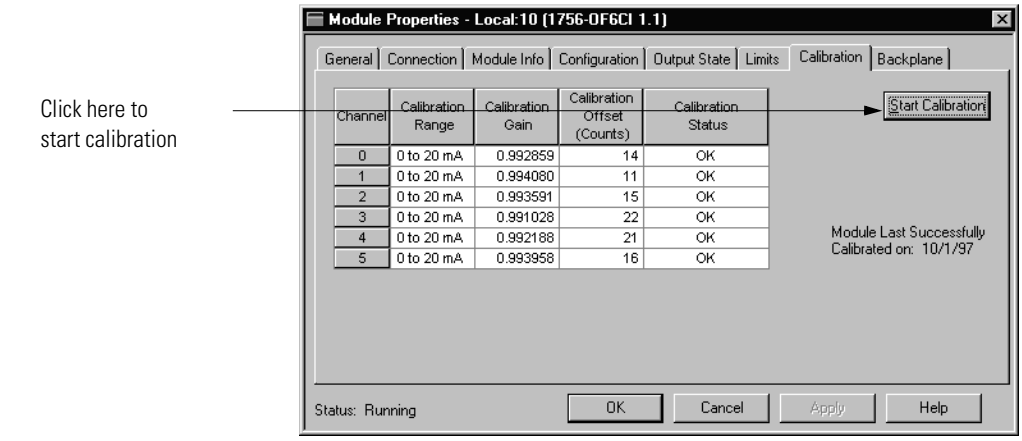
This module must be calibrated for current. RSLogix 5000 commands the module to output specific levels of current. You must measure the actual level and record the results. This measurement allows the module to account for any inaccuracies.

While you are online, you must access the modules' properties page. To see how to reach this page, see page 10-17.

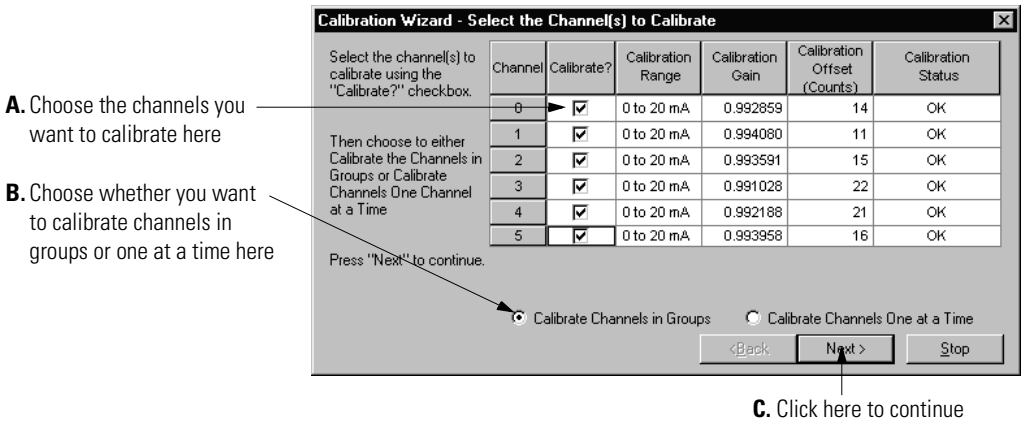
Follow these steps:

1. Connect your current meter to the module.

2. Go to the Calibration page. (Click on the tab for this page.)

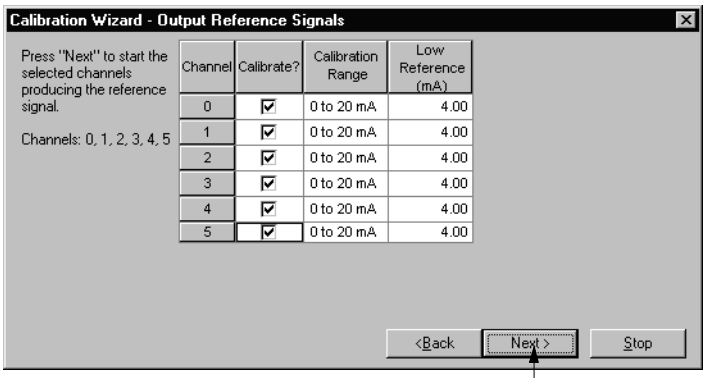



3. Set the channels to be calibrated.


A. Choose the channels you want to calibrate here
B. Choose whether you want to calibrate channels in groups or one at a time here
Calibration Wizard - Select the Channel(s) to Calibrate
Select the channel(s) to calibrate using the "Calibrate?" checkbox.
Then choose to either Calibrate the Channels in Groups or Calibrate Channels One Channel at a Time
Press "Next" to continue.
Channel
Calibrate?
Calibration Range
Calibration Gain
Calibration Offset (Counts)
Calibration Status
0 0 to 20 mA 0.992859 14 OK
1 0 to 20 mA 0.994080 11 OK
2 0 to 20 mA 0.993591 15 OK
3 0 to 20 mA 0.991028 22 OK
4 0 to 20 mA 0.992188 21 OK
5 0 to 20 mA 0.993958 16 OK
Calibrate Channels in Groups
Calibrate Channels One at a Time
<Back
Next >
Stop
C. Click here to continue

The low reference screen appears first.

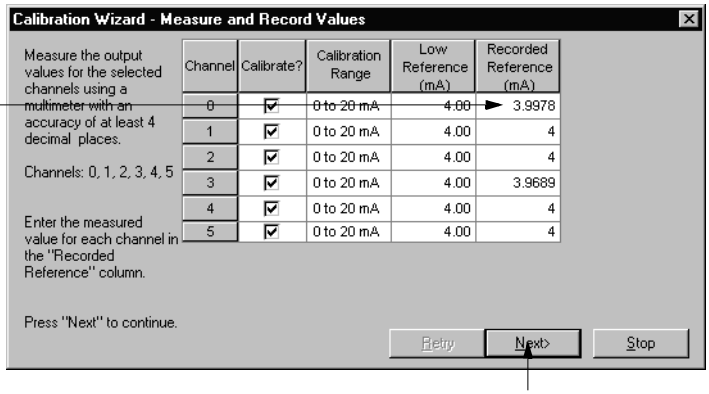
This screen shows which channels will be calibrated for a low reference and the range of that calibration


Calibration Wizard - Output Reference Signals
Press "Next" to start the selected channels producing the reference signal.
Channels: 0, 1, 2, 3, 4, 5
Channel
Calibrate?
Calibration Range
Low Reference (mA)
0 0 to 20 mA 4.00
1 0 to 20 mA 4.00
2 0 to 20 mA 4.00
3 0 to 20 mA 4.00
4 0 to 20 mA 4.00
5 0 to 20 mA 4.00
<Back
Next >
Stop

Click here to calibrate the low reference

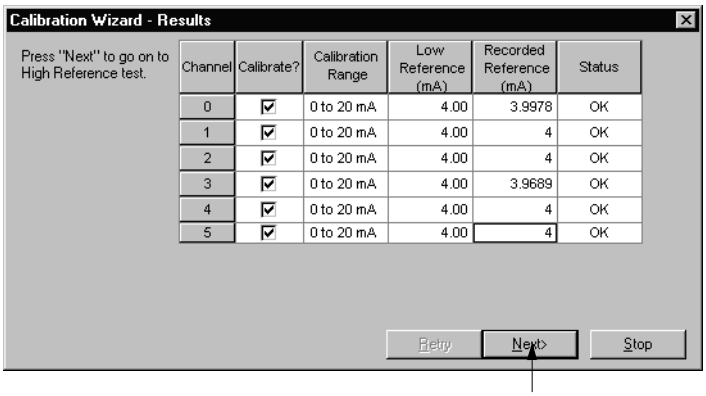
**4.** Record the results of your measurement.

Record measurement values here


Calibration Wizard - Measure and Record Values
Measure the output values for the selected channels using a multimeter with an accuracy of at least 4 decimal places.
Channels: 0, 1, 2, 3, 4, 5
Enter the measured value for each channel in the "Recorded Reference" column.
Press "Next" to continue.
Channel
Calibrate?
Calibration Range
Low Reference (mA)
Recorded Reference (mA)
0 0 to 20 mA 4.00 3.9978
1 0 to 20 mA 4.00 4
2 0 to 20 mA 4.00 4
3 0 to 20 mA 4.00 3.9689
4 0 to 20 mA 4.00 4
5 0 to 20 mA 4.00 4
Retry
Next>
Stop

Click here to continue

This screen displays the status of each channel after calibrating for a low reference. If all channels are OK, continue, as shown below. If any channels report an Error, return to step 3 until the status is OK.

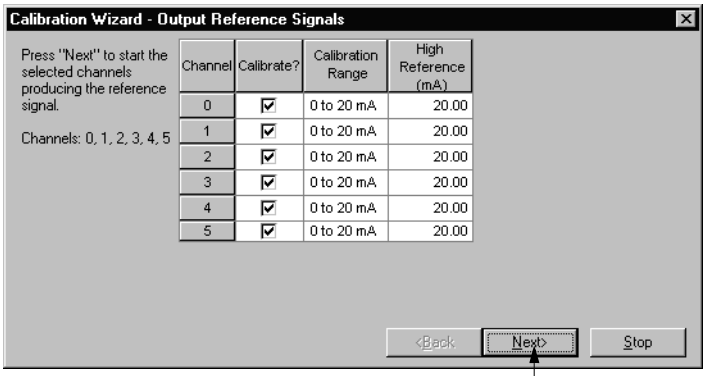

Calibration Wizard - Results
Press "Next" to go on to High Reference test.
Channel
Calibrate?
Calibration Range
Low Reference (mA)
Recorded Reference (mA)
Status
0 0 to 20 mA 4.00 3.9978 OK
1 0 to 20 mA 4.00 4 OK
2 0 to 20 mA 4.00 4 OK
3 0 to 20 mA 4.00 3.9689 OK
4 0 to 20 mA 4.00 4 OK
5 0 to 20 mA 4.00 4 OK
Retry
Next>
Stop

Click here to continue

Now you must calibrate each channel for a high reference voltage.

**5.** Set the channels to be calibrated.

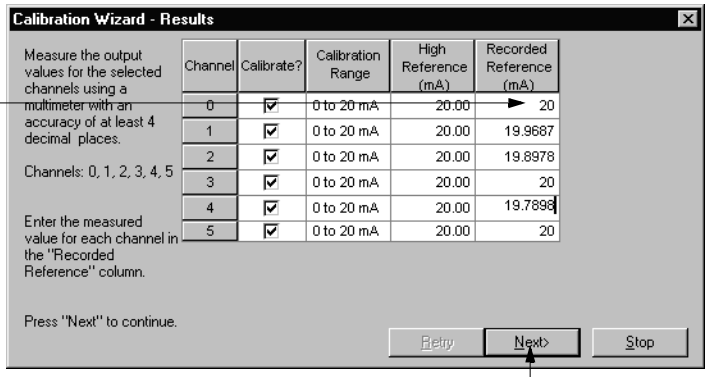
This screen shows which channels will be calibrated for a high reference and the range of that calibration




Click here to calibrate the high reference

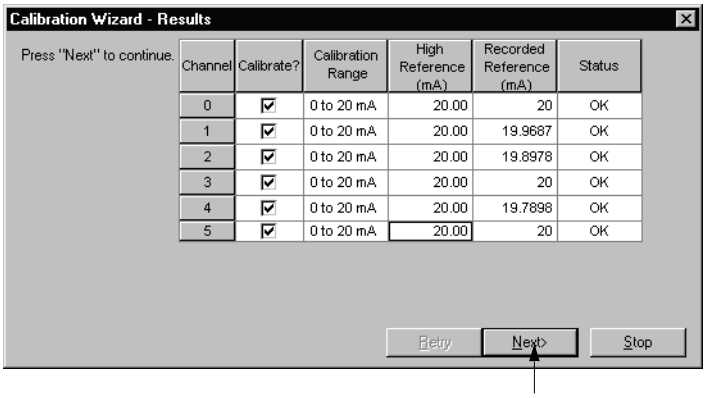
**6.** Record the measurement.

Record measurement values here

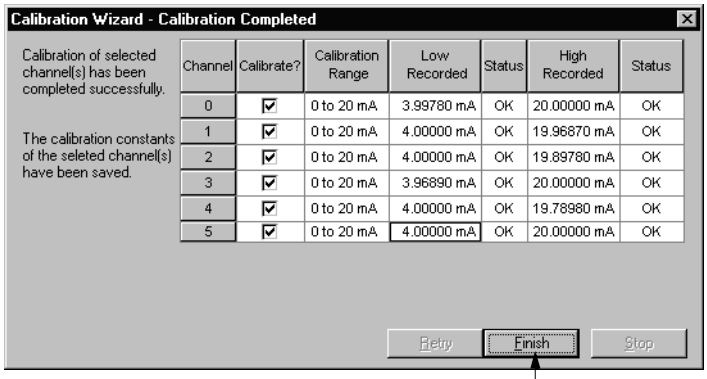



Click here to continue

This screen displays the status of each channel after calibrating for a high reference. If all channels are OK, continue, as shown below. If any channels report an Error, return to step 5 until the status is OK.




After you have completed both low and high reference calibration, this screen shows the status of both and allows you to finish the calibration process and return to normal operation.



## Calibrating the 1756-OF6VI

This module must be calibrated for voltage. RSLogix 5000 commands the module to output specific levels of voltage. You must measure the actual level and record the results. This measurement allows the module to account for any inaccuracies.

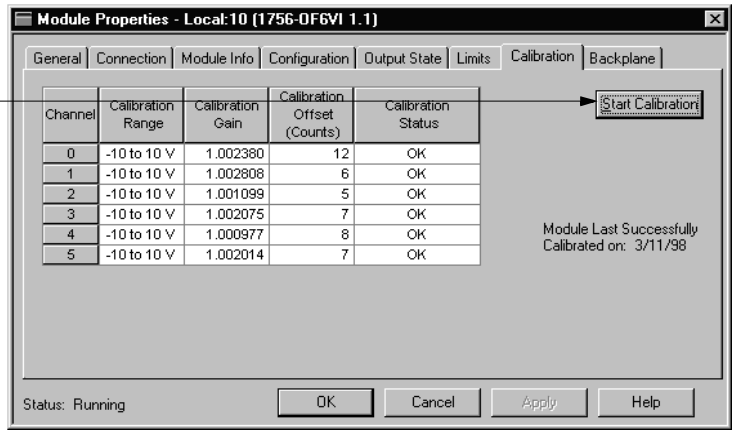
While you are online, you must access the modules' properties page. To see how to reach this page, see page 10-17.

Follow these steps:

1. Connect your voltage meter to the module.

2. Go to the Calibration page. (Click on the tab for this page.)

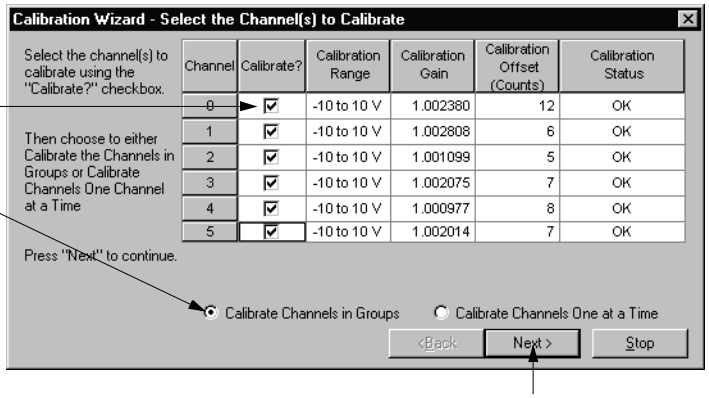
Click here to start calibration




3. Set the channels to be calibrated.

**A.** Choose the channels you want to calibrate here

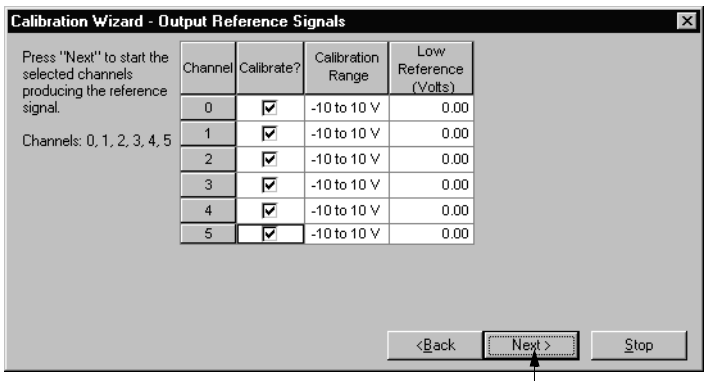
**B.** Choose whether you want to calibrate channels in groups or one at a time here


Calibration Wizard - Select the Channel(s) to Calibrate
Select the channel(s) to calibrate using the "Calibrate?" checkbox.
Then choose to either Calibrate the Channels in Groups or Calibrate Channels One Channel at a Time
Press "Next" to continue.
Channel
Calibrate?
Calibration Range
Calibration Gain
Calibration Offset (Counts)
Calibration Status
0 -10 to 10 V 1.002380 12 OK
1 -10 to 10 V 1.002808 6 OK
2 -10 to 10 V 1.001099 5 OK
3 -10 to 10 V 1.002075 7 OK
4 -10 to 10 V 1.000977 8 OK
5 -10 to 10 V 1.002014 7 OK
Calibrate Channels in Groups
Calibrate Channels One at a Time
<Back
Next >
Stop

**C.** Click here to continue

The low reference screen appears first.

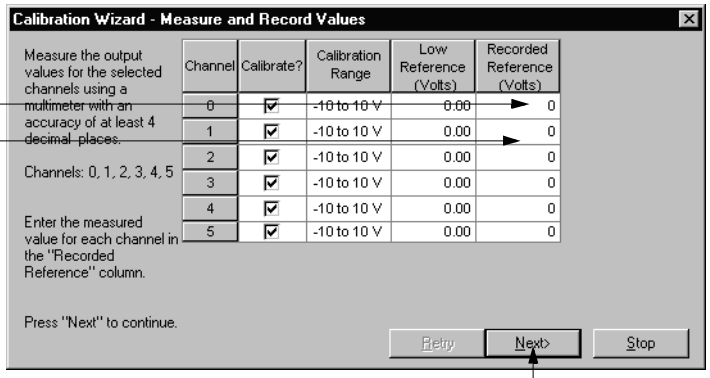
This screen shows which channels will be calibrated for a low reference and the range of that calibration


Calibration Wizard - Output Reference Signals
Press "Next" to start the selected channels producing the reference signal.
Channels: 0, 1, 2, 3, 4, 5
Channel
Calibrate?
Calibration Range
Low Reference (Volts)
0 -10 to 10 V 0.00
1 -10 to 10 V 0.00
2 -10 to 10 V 0.00
3 -10 to 10 V 0.00
4 -10 to 10 V 0.00
5 -10 to 10 V 0.00
<Back
Next >
Stop

Click here to calibrate the low reference

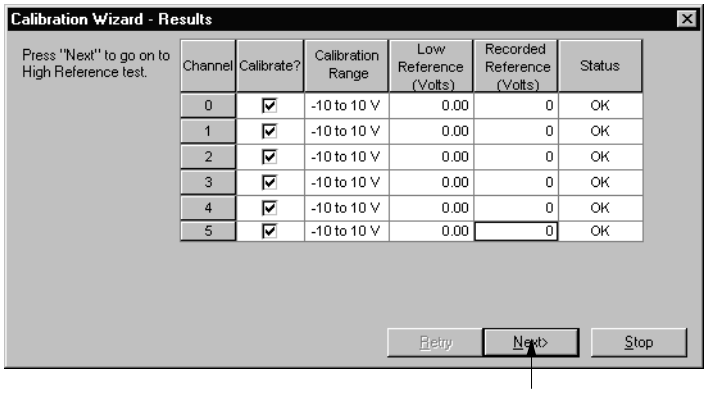
**4.** Record the results of your measurement.

Record measurement values here


Calibration Wizard - Measure and Record Values
Measure the output values for the selected channels using a multimeter with an accuracy of at least 4 decimal places.
Channels: 0, 1, 2, 3, 4, 5
Enter the measured value for each channel in the "Recorded Reference" column.
Press "Next" to continue.
Channel
Calibrate?
Calibration Range
Low Reference (Volts)
Recorded Reference (Volts)
0 -10 to 10 V 0.00 0
1 -10 to 10 V 0.00 0
2 -10 to 10 V 0.00 0
3 -10 to 10 V 0.00 0
4 -10 to 10 V 0.00 0
5 -10 to 10 V 0.00 0
Retry
Next>
Stop

Click here to continue

This screen displays the status of each channel after calibrating for a low reference. If all channels are OK, continue, as shown below. If any channels report an Error, return to step 3 until the status is OK.

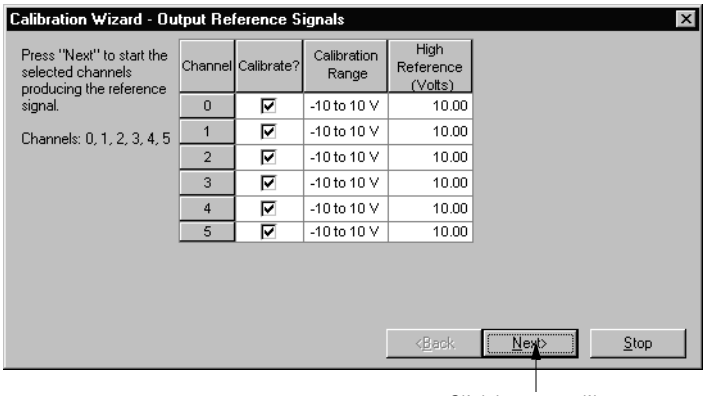

Calibration Wizard - Results
Press "Next" to go on to High Reference test.
Channel
Calibrate?
Calibration Range
Low Reference (Volts)
Recorded Reference (Volts)
Status
0 -10 to 10 V 0.00 0 OK
1 -10 to 10 V 0.00 0 OK
2 -10 to 10 V 0.00 0 OK
3 -10 to 10 V 0.00 0 OK
4 -10 to 10 V 0.00 0 OK
5 -10 to 10 V 0.00 0 OK
Retry
Next>
Stop

Click here to continue

Now you must calibrate each channel for a high reference voltage.

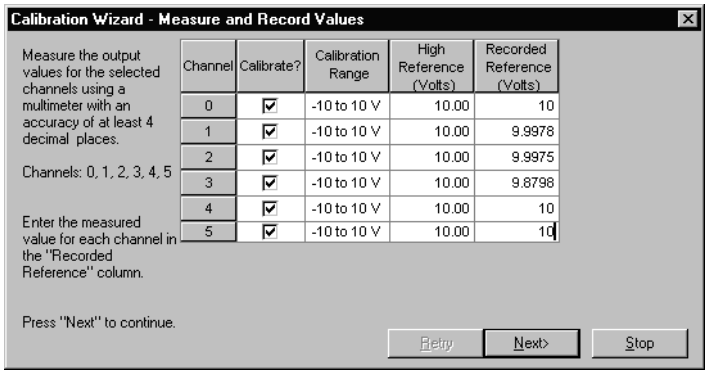
**5.** Set the channels to be calibrated.

This screen shows which channels will be calibrated for a high reference and the range of that calibration

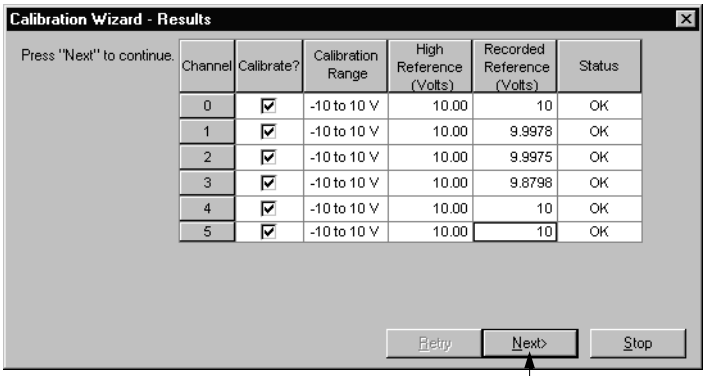

Calibration Wizard - Output Reference Signals
Press "Next" to start the selected channels producing the reference signal.
Channels: 0, 1, 2, 3, 4, 5
Channel
Calibrate?
Calibration Range
High Reference (Volts)
0 -10 to 10 V 10.00
1 -10 to 10 V 10.00
2 -10 to 10 V 10.00
3 -10 to 10 V 10.00
4 -10 to 10 V 10.00
5 -10 to 10 V 10.00
<Back
Next>
Stop

Click here to calibrate the high reference

**6.** Record the measurement.

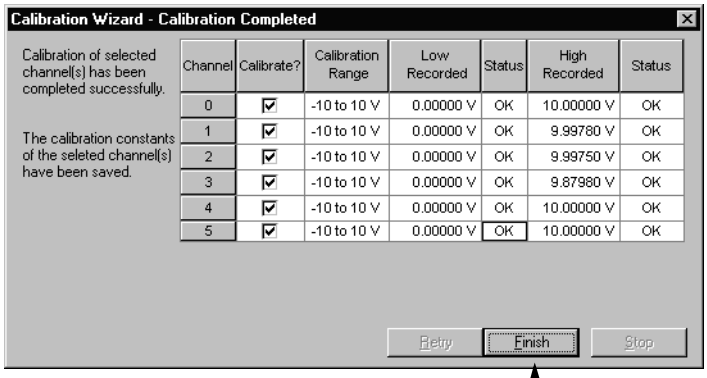

Calibration Wizard - Measure and Record Values
Measure the output values for the selected channels using a multimeter with an accuracy of at least 4 decimal places.
Channels: 0, 1, 2, 3, 4, 5
Enter the measured value for each channel in the "Recorded Reference" column.
Press "Next" to continue.
Channel
Calibrate?
Calibration Range
High Reference (Volts)
Recorded Reference (Volts)
0 -10 to 10 V 10.00 10
1 -10 to 10 V 10.00 9.9978
2 -10 to 10 V 10.00 9.9975
3 -10 to 10 V 10.00 9.8798
4 -10 to 10 V 10.00 10
5 -10 to 10 V 10.00 10
Retry
Next>
Stop

This screen displays the status of each channel after calibrating for a high reference. If all channels are OK, continue, as shown below. If any channels report an Error, return to step 5 until the status is OK.


Calibration Wizard - Results
Press "Next" to continue.
Channel
Calibrate?
Calibration Range
High Reference (Volts)
Recorded Reference (Volts)
Status
0 -10 to 10 V 10.00 10 OK
1 -10 to 10 V 10.00 9.9978 OK
2 -10 to 10 V 10.00 9.9975 OK
3 -10 to 10 V 10.00 9.8798 OK
4 -10 to 10 V 10.00 10 OK
5 -10 to 10 V 10.00 10 OK
Retry
Next>
Stop

Click here to continue

After you have completed both low and high reference calibration, this screen shows the status of both and allows you to finish the calibration process and return to normal operation.


Calibration Wizard - Calibration Completed
Calibration of selected channel(s) has been completed successfully.
The calibration constants of the seleted channel(s) have been saved.
Channel
Calibrate?
Calibration Range
Low Recorded
Status
High Recorded
Status
0 -10 to 10 V 0.00000 V OK 10.00000 V OK
1 -10 to 10 V 0.00000 V OK 9.99780 V OK
2 -10 to 10 V 0.00000 V OK 9.99750 V OK
3 -10 to 10 V 0.00000 V OK 9.87980 V OK
4 -10 to 10 V 0.00000 V OK 10.00000 V OK
5 -10 to 10 V 0.00000 V OK 10.00000 V OK
Retry
Finish
Stop
Click here to finish calibration and return the module to normal operation

## Chapter Summary and What's Next

In this chapter, you read about Calibrating the ControlLogix Analog I/O Modules.

Chapter 12 describes Troubleshooting Your ControlLogix Analog I/O Module.

# Troubleshooting Your ControlLogix Analog I/O Module

## Chapter Objectives

This chapter describes the indicators on ControlLogix analog I/O modules, and how to use them in troubleshooting.


| For information about: | See page: |
|---|---|
| Using Module Indicators to Troubleshoot Your Module | 12-1 |
| Using RSLogix 5000 to Troubleshoot Your Module | 12-3 |


## Using Module Indicators to Troubleshoot Your Module

Each ControlLogix analog I/O module has indicators that display module status. Table 12.1 lists the indicators used on ControlLogix analog input modules:

**Table 12.1 LED Indicators for Input Modules**

| LED indicators: | This display: | Means: | Take this action: |
|---|---|---|---|
| OK | Steady green light | The inputs are being multicast and in normal operating state. | None |
| OK | Flashing green light | The module has passed internal diagnostics but is not currently performing connected communication. | None |
| OK | Flashing red light | Previously established communication has timed out. | Check controller and chassis communication |
| OK | Steady red light | The module must be replaced. | Replace the module. |
| CAL | Flashing green light | The module is in calibration mode. | Finish calibration |

Figure 12.1 shows the LED display used with input modules.

**Figure 12.1**

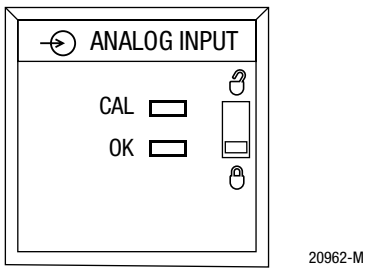


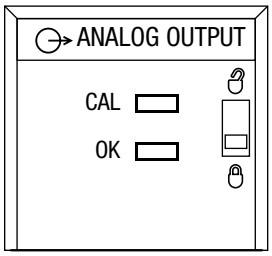
Table 12.2 lists the indicators used on ControlLogix analog output modules:

**Table 12.2 LED Indicators for Output Modules**

| LED indicators: | This display: | Means: | Take this action: |
|---|---|---|---|
| OK | Steady green light | The outputs are in a normal operating state in Run Mode. | None |
| OK | Flashing green light | Either:<br>• the module has passed internal diagnostics and is not actively controlled<br>or<br>• a connection is open and the controller is in program mode. | None |
| OK | Flashing red light | Previously established communication has timed out. | Check controller and chassis communication |
| OK | Steady red light | The module must be replaced. | Replace the module. |
| CAL | Flashing green light | The module is in calibration mode. | Finish calibration |

Figure 12.2 shows the LED display used with analog output modules.

**Figure 12.2**

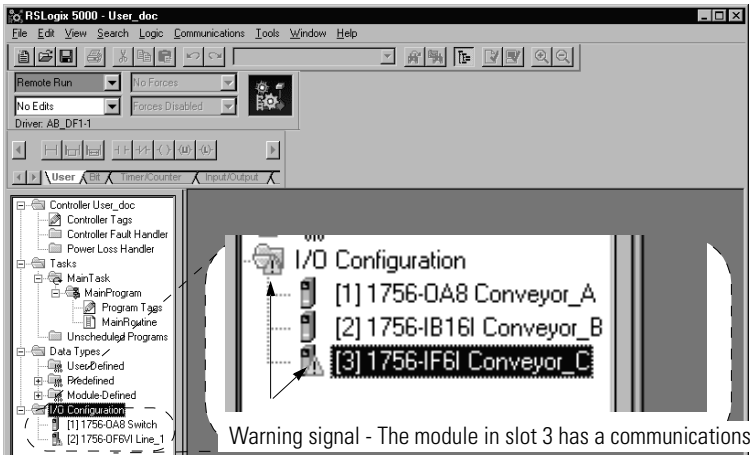


## Using RSLogix 5000 to Troubleshoot Your Module

In addition to the LED display on the module, RSLogix 5000 alerts you to fault conditions. You will be alerted in one of three ways:

- Warning signal on the main screen next to the module-This occurs when the connection to the module is broken.

Warning icon when a communications fault occurs or if the module is inhibited

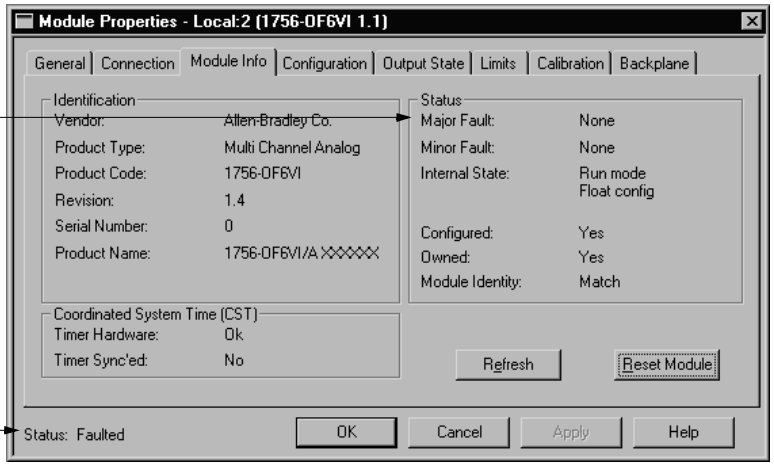



Warning signal - The module in slot 3 has a communications fault

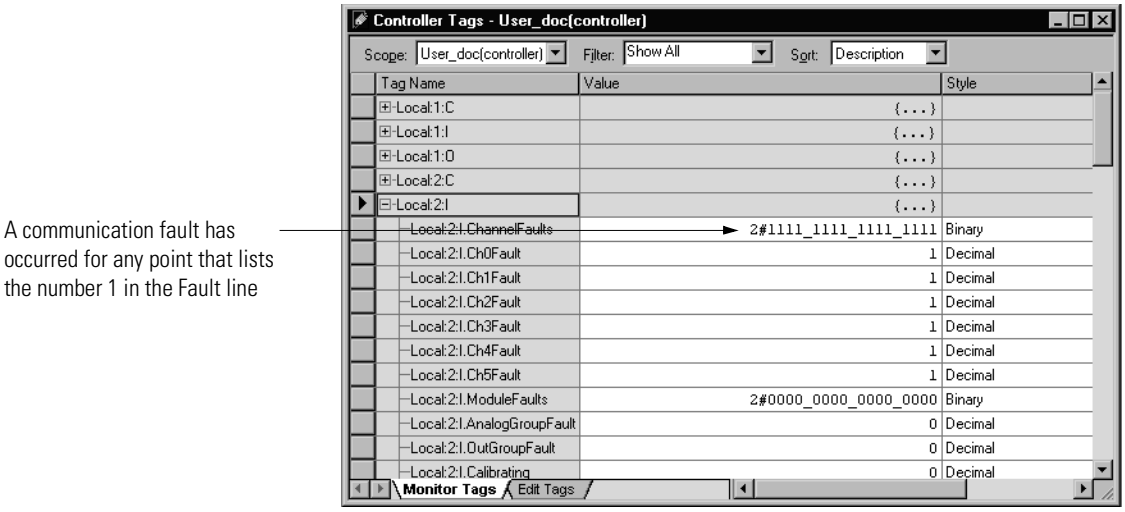
- Fault message in a screen's status line

Status section lists Major and Minor Faults and the Internal State of the module

Status line provides information on the connection to the module



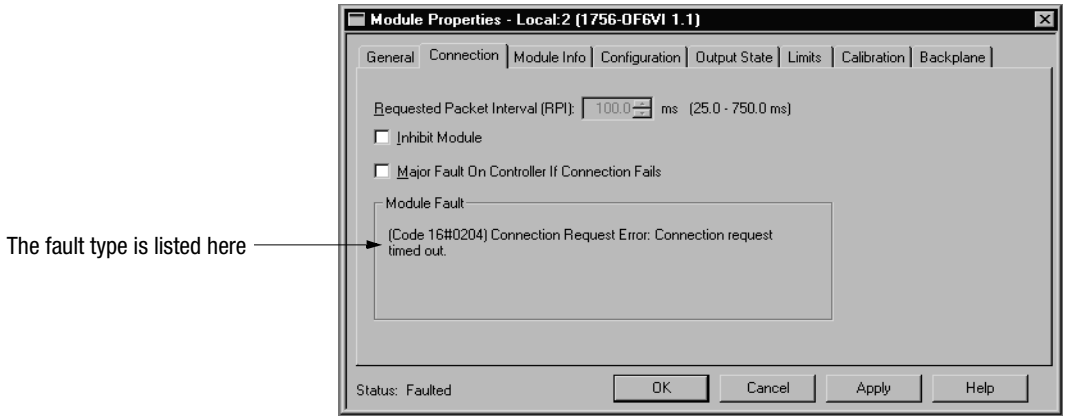
- Notification in the Tag Editor - General module faults are also reported in the Tag Editor. Diagnostic faults are only reported in the Tag Editor




- Status on the Module Info Page

## Determining Fault Type

When you are monitoring a module's configuration properties in RSLogix 5000 and receive a Communications fault message, the Connection page lists the type of fault.




For a detailed listing of the possible faults, their causes and suggested solutions, see Module Faults in the online help.

## Chapter Summary and What's Next

In this chapter you learned about troubleshooting the module.

Move on to Appendix A to see the Specifications for each module.

# Specifications

Table A.1 lists where you can find specifications for the ControlLogix analog I/O modules.

**Table A.1**

| For: | See page: |
|---|---|
| 1756-IF16 Specifications | A-2 |
| 1756-IF6CIS Specifications | A-4 |
| 1756-IF6I Specifications | A-6 |
| 1756-IF8 Specifications | A-8 |
| 1756-IR6I Specifications | A-10 |
| 1756-IT6I Specifications | A-12 |
| 1756-IT6I2 Specifications | A-14 |
| 1756-OF4 Specifications | A-16 |
| 1756-OF6CI Specifications | A-18 |
| 1756-OF6VI Specifications | A-20 |
| 1756-OF8 Specifications | A-22 |

# 1756-IF16 Specifications

| | |
|---|---|
| Number of Inputs | 16 single ended, 8 differential or 4 differential (high speed) |
| Module Location | 1756 ControlLogix Chassis |
| Backplane Current | 150mA @ 5.1V dc & 65mA @ 24V dc |
| Backplane Power | 2.33W |
| Power Dissipation within Module | 2.3W – Voltage<br>3.9W – Current |
| Thermal Dissipation | 7.84 BTU/hr. – Voltage<br>13.30 BTU/hr. – Current |
| Input Range and Resolution | +/-10.25V – 320μV/count (15 bits plus sign bipolar)<br>0-10.25V – 160μV/count (16 bits)<br>0-5.125V – 80μV/count (16 bits)<br>0-20.5mA – 0.32μA/count (16 bits) |
| Common Mode Voltage Range | +/- 10.25V (20.5V between any two input terminals) |
| Data Format | Left justified, 2s complement – Integer mode<br>IEEE 32 bit – Floating point mode |
| Input Impedance | >1megΩ – Voltage<br>249Ω – Current |
| Open Circuit Detection Time | Positive full scale reading within 5s – Differential Voltage<br>Negative full scale reading within 5s – Single-ended/Differential Current<br>Even numbered channels go to positive full scale reading within 5s, odd numbered channels go to negative full scale reading within 5s – Single-ended voltage |
| Overvoltage Protection | 30V dc – Voltage<br>8V dc – Current |
| Normal Mode Noise Rejection[1] | >80dB at 50/60Hz |
| Common Mode Noise Rejection | >100dB at 50/60Hz |
| Calibrated Accuracy | Better than 0.05% of range – Voltage<br>Better than 0.15% of range – Current |
| Calibration Interval | 12 months |
| Input Offset Drift with Temperature | 90μV/°C |
| Gain Drift with Temperature | 15 ppm/°C – Voltage<br>307.5μV/°C for +/-10.25V range; 153.8μV/°C for 0-10.25V range; 76.9μV/°C for 0-5.125V range<br>20 ppm/°C – Current<br>+/-0.41μA/°C |
| Module Error over Full Temperature Range[2] | 0.1% of range – Voltage<br>0.3% of range – Current |
| Module Conversion Method | Sigma-Delta |
| Isolation Voltage<br>User to system | <br>250V<br>100% tested at 2550V dc for 1s |
| Module Scan Time for All Channels (Sample Rate Module Filter Dependent) | 16-488ms – 16-point single ended<br>8-244ms – 8-point differential<br>5-122ms – 4-point differential - |
| RTB Screw Torque (Cage clamp) | 4.4 inch-pounds (0.4Nm) |
| Module Keying (Backplane) | Electronic |
| RTB Keying | User defined |
| Field Wiring Arm and Housing | 36 Position RTB (1756-TBCH or TBS6H)[3] |

| Environmental Conditions | |
|---|---|
| Operating Temperature | IEC 60068-2-1 (Test Ad, Operating Cold),<br>IEC 60068-2-2 (Test Bd, Operating Dry Heat),<br>IEC 60068-2-14 (Test Nb, Operating Thermal Shock):<br>0 to 60°C (32 to 140°F) |
| Storage Temperature | IEC 60068-2-1 (Test Ab, Un-packaged Non-operating Cold),<br>IEC 60068-2-2 (Test Bb, Un-packaged Non-operating Dry Heat),<br>IEC 60068-2-14 (Test Na, Un-packaged Non-operating Thermal Shock):<br>–40 to 85°C (–40 to 185°F) |
| Relative Humidity | IEC 60068-2-30 (Test Db, Un-packaged Non-operating Damp Heat):<br>5 to 95% non-condensing |
| Vibration | IEC60068-2-6 (Test Fc, Operating):<br>2g @ 10-500Hz |
| Shock | IEC60068-2-27 (Test Ea, Unpackaged shock):<br>Operating 30g<br>Non-operating 50g |
| Emissions | CISPR 11:<br>Group 1, Class A |
| ESD Immunity | IEC 61000-4-2:<br>6kV contact discharges<br>8kV air discharges |
| Radiated RF Immunity | IEC 61000-4-3:<br>10V/m with 1kHz sine-wave 80%AM from 30MHz to 1000MHz<br>10V/m with 200Hz 50% Pulse 100%AM at 900Mhz |
| EFT/B Immunity | IEC 61000-4-4:<br>±2kV at 5kHz on signal ports |
| Surge Transient Immunity | IEC 61000-4-5:<br>±2kV line-earth (CM) on shielded ports |
| Conducted RF Immunity | IEC 61000-4-6:<br>10Vrms with 1kHz sine-wave 80%AM from 150kHz to 80MHz |
| Enclosure Type Rating | None (open-style) |
| Conductors<br>Wire Size<br>Category | <br>#22 to #14 AWG (0.324 to 2.08 sq. mm) stranded [2]<br>3/64 inch (1.2mm) insulation maximum<br>2[4], [5] |
| Screwdriver Width for RTB | 1/8 inch (3.2mm) maximum |
| Certifications<br>(when product is marked) | UL — UL Listed Industrial Control Equipment<br>CSA — CSA Certified Process Control Equipment<br>CSA — CSA Certified Process Control Equipment for Class I, Division 2 Group A,B,C,D Hazardous Locations<br>FM — FM Approved Equipment for use in Class I Division 2 Group A,B,C,D Hazardous Locations<br>CE[6] — European Union 89/336/EEC EMC Directive, compliant with:<br>EN 50082-2; Industrial Immunity<br>EN 61326; Meas./Control/Lab., Industrial Requirements<br>EN 61000-6-2; Industrial Immunity<br>EN 61000-6-4; Industrial Emissions<br>C-Tick[5] — Australian Radiocommunications Act, compliant with:<br>AS/NZS 2064; Industrial Emissions<br>EEx[5] — European Union 94/9/EEC ATEX Directive, compliant with:<br>EN 50021; Potentially Explosive Atmospheres, Protection "n" |

(1) This specification is module filter dependent.

(2) For more information on this specification, see Appendix E.

(3) Maximum wire size requires the extended housing - 1756-TBE.

(4) Use this conductor category information for planning conductor routing as described in the system level installation manual.

(5) Refer to publication 1770-4.1 *Industrial Automation Wiring and Grounding Guidelines*.

(6) See the Product Certification link at www.ab.com for Declarations of Conformity, Certificates, and other certification details.

# 1756-IF6CIS Specifications

| | |
|---|---|
| Number of Inputs | 6 points isolated |
| Module Location | ControlLogix Chassis |
| Backplane Current | 250 mA @ 5.1V dc & 275 mA @ 24V dc |
| Backplane Power | 7.9W |
| Module Power Dissipation | 5.1W @ 60° C |
| Thermal Dissipation | 17.4 BTU/hr. |
| Input Range | 0-21mA (Over-range indication when exceeded) |
| Resolution 0-21mA | 0.34μA/bit 16bit (15.9bits) |
| Data Format | Left justified, 2's complement – Integer Mode<br>IEEE32 bit – Floating Point |
| Input Impedance | Approximately 215 ohm |
| Sourcing Voltage | 20V dc minimum<br>30V dc maximum |
| Sourcing Current | Current limited to <30mA maximum |
| Open Circuit Detection Time | Zero reading within 5 seconds |
| Overvoltage Protection | 30V AC/DC with PTC and Sense Resistor |
| Normal Mode Noise Rejection(1) | 60dB at 60Hz |
| Common Mode Noise Rejection | 120dB at 60Hz, 100 dB at 50Hz |
| Channel Bandwidth(1) | 3-262Hz (-3dB) |
| Settling Time to % of Full Scale(1) | 5% of FS: <80 milliseconds |
| Calibrated Accuracy(2)<br>Typical<br>Worst case | <br>Better than 0.025% of range<br>Better than 0.1% of range |
| Calibration Interval | 12 months |
| Input Offset Drift with Temperature | 200nA/°C |
| Gain Drift with Temperature(2)<br>Typical<br><br>Worst Case | <br>17 ppm/°C<br>0.36μA/°C<br>35 ppm/°C<br>0.74μA/°C |
| Module Error over Full Temperature Range(2) | 0.2% of range |
| Module Scan Time for all Channels (Sample Rate) | 25 milliseconds minimum – Floating Point Mode<br>10 milliseconds minimum – Integer Mode |
| Isolation Voltage<br>Channel to channel<br><br>User to system | Optically Isolated, Transformer Coupled<br>250V<br>100% tested at 1900V dc for 2 s<br>250V<br>100% tested at 1900V dc for 2 s |
| Module Conversion Method | Sigma-Delta |
| RTB Screw Torque (NEMA clamp) | 7-9 inch-lbs (.8 to 1Nm) |
| Module Keying (Backplane) | Electronic |
| RTB Keying | User defined |
| RTB and Housing | 20 Position RTB (1756-TBNH or TBSH)(3) |

| | |
|---|---|
| Conductors<br>Wire Size<br>Category | <br>#22 to #14 AWG (0.324 to 2.08 sq. mm) stranded[2]<br>3/64 inch (1.2mm) insulation maximum<br>2[4], [5] |
| Screwdriver Blade Width for RTB | 5/16 inch (8mm) maximum |
| Environmental Conditions | |
| Operating Temperature | IEC 60068-2-1 (Test Ad, Operating Cold),<br>IEC 60068-2-2 (Test Bd, Operating Dry Heat),<br>IEC 60068-2-14 (Test Nb, Operating Thermal Shock):<br>0 to 60°C (32 to 140°F) |
| Storage Temperature | IEC 60068-2-1 (Test Ab, Un-packaged Non-operating Cold),<br>IEC 60068-2-2 (Test Bb, Un-packaged Non-operating Dry Heat),<br>IEC 60068-2-14 (Test Na, Un-packaged Non-operating Thermal Shock):<br>-40 to 85°C (-40 to 185°F) |
| Relative Humidity | IEC 60068-2-30 (Test Db, Un-packaged Non-operating Damp Heat):<br>5 to 95% non-condensing |
| Vibration | IEC 60068-2-6 (Test Fc, Operating):<br>2g @ 10-500Hz |
| Operating Shock | IEC 60068-2-27 (Test Ea, Unpackaged Shock):<br>30g |
| Non-operating Shock | IEC 60068-2-27 (Test Ea, Unpackaged Shock):<br>50g |
| Emissions | CISPR 11:<br>Group 1, Class A |
| ESD Immunity | IEC 61000-4-2:<br>6kV contact discharges<br>8kV air discharges |
| Radiated RF Immunity | IEC 61000-4-3:<br>10V/m with 1kHz sine-wave 80%AM from 30MHz to 2000MHz<br>10V/m with 200Hz 50% Pulse 100%AM at 900Mhz |
| EFT/B Immunity | IEC 61000-4-4:<br>±2kV at 5kHz on signal ports |
| Surge Transient Immunity | IEC 61000-4-5:<br>±2kV line-earth(CM) on shielded ports |
| Conducted RF Immunity | IEC 61000-4-6:<br>10Vrms with 1kHz sine-wave 80%AM from 150kHz to 80MHz |
| Enclosure Type Rating | None (open-style) |
| Certifications: (when product is marked) | UL — UL Listed Industrial Control Equipment<br>CSA — CSA Certified Process Control Equipment<br>CSA — CSA Certified Process Control Equipment for Class I, Division 2 Group A,B,C,D Hazardous Locations<br>CE[6] — European Union 89/336/EEC EMC Directive, compliant with:<br>EN 50082-2; Industrial Immunity<br>EN 61326; Meas./Control/Lab., Industrial Requirements<br>EN 61000-6-2; Industrial Immunity<br>EN 61000-6-4; Industrial Emissions<br>C-Tick[5] — Australian Radiocommunications Act, compliant with:<br>AS/NZS CISPR 11; Industrial Emissions |

(1) These specifications are notch filter dependant.

(2) For more information on this specification, see Appendix E.

(3) Maximum wire size will require extended housing - 1756-TBE.

(4) Use this conductor category information for planning conductor routing as described in the system level installation manual.

(5) Refer to publication 1770-4.1 *Industrial Automation Wiring and Grounding Guidelines*.

(6) See the Product Certification link at www.ab.com for Declarations of Conformity, Certificates, and other certification details.

# 1756-IF6I Specifications

| | |
|---|---|
| Number of Inputs | 6 individually isolated channels |
| Module Location | 1756 ControlLogix Chassis |
| Backplane Current<br>(No module external power requirements) | 250mA @5.1V dc & 100mA @ 24V dc |
| Backplane Power | 3.7W |
| Power Dissipation within Module | 3.7W - Voltage<br>4.3W - Current |
| Thermal Dissipation | 12.62 BTU/hr. - Voltage<br>14.32 BTU/hr. - Current |
| Input Range | +/-10.5V, 0-10.5V, 0-5.25V, 0-21mA (overrange indication when exceeded) |
| Resolution<br>+/-10.5V range<br>0 to 10.5V range<br>0 to 5.25V range<br>0-21mA range | Approximately 16 bits across each range shown below<br>343µV/count<br>171µV/count<br>86µV/count<br>0.34µA/count |
| Data Format | 2s complement – Integer mode<br>IEEE 32 bit – Floating point mode |
| Input Impedance | >10MΩ – Voltage<br>249Ω – Current |
| Open Circuit Detection Time | Positive full scale reading within 5s |
| Overvoltage Protection | 120V ac/dc – Voltage<br>8V ac/dc with on-board current resistor – Current |
| Normal Mode Noise Rejection[1] | 60dB at 60Hz |
| Common Mode Noise Rejection | 120dB at 60Hz, 100dB at 50Hz |
| Channel Bandwidth[1] | 15Hz (-3dB) |
| Settling Time to 5% of Full Scale[1] | <80ms |
| Calibrated Accuracy[2]<br>Typical<br>Worst case | <br>Better than 0.05% of range<br>Better than 0.1% of range |
| Calibration Interval | 12 months |
| Input Offset Drift with Temperature | 2µV/°C |
| Gain Drift with Temperature[2]<br>Typical<br><br><br>Worst Case | <br>35 ppm/°C – Voltage<br>735µV/°C for +/-10.5V range; 367.5µV/°C for 0-10.5V range; 183.8µV/°C for 0-5.25V range<br>45 ppm/°C – Current<br>+/-0.945µA/°C<br>80 ppm/°C – Voltage<br>1680µV/°C for +/-10.5V range; 840µV/°C for 0-10.5V range; 420µV/°C for 0-5.25V range<br>90 ppm/°C – Current<br>+/-1.89µA/°C |
| Module Error over Full Temperature Range[2] | 0.54% of range |
| Minimum Module Scan Time for all Channels (Sample Rate)[1] | 25ms minimum – Floating Point Mode<br>10ms minimum – Integer Mode |
| Isolation Voltage<br>Channel to channel<br>User to system | Optoisolated, transformer isolated<br>100% tested at 1700V dc for 1s, based on 250V ac<br>100% tested at 1700V dc for 1s, based on 250V ac |
| Module Conversion Method | Sigma-Delta |
| Module Keying (Backplane) | Electronic |
| RTB Screw Torque (NEMA) | 7-9 inch-pounds (0.8-1Nm) |
| RTB Keying | User defined |
| RTB and Housing | 20 Position RTB (1756-TBNH or TBSH)[3] |

| | |
|---|---|
| Conductors<br>Wire Size<br><br>Category | <br>#22 to #14 AWG (0.324 to 2.08 sq. mm) stranded[3]<br>3/64 inch (1.2mm) insulation maximum<br>2[4], [5] |
| Screwdriver Blade Width for RTB | 5/16 inch (8mm) maximum |
| Environmental Conditions | |
| Operating Temperature | IEC 60068-2-1 (Test Ad, Operating Cold),<br>IEC 60068-2-2 (Test Bd, Operating Dry Heat),<br>IEC 60068-2-14 (Test Nb, Operating Thermal Shock):<br>0 to 60°C (32 to 140°F) |
| Storage Temperature | IEC 60068-2-1 (Test Ab, Un-packaged Non-operating Cold),<br>IEC 60068-2-2 (Test Bb, Un-packaged Non-operating Dry Heat),<br>IEC 60068-2-14 (Test Na, Un-packaged Non-operating Thermal Shock):<br>-40 to 85°C (-40 to 185°F) |
| Relative Humidity | IEC 60068-2-30 (Test Db, Un-packaged Non-operating Damp Heat):<br>5 to 95% non-condensing |
| Vibration | IEC 60068-2-6 (Test Fc, Operating):<br>2g @ 10-500Hz |
| Operating Shock | IEC 60068-2-27 (Test Ea, Unpackaged Shock):<br>30g |
| Non-operating Shock | IEC 60068-2-27 (Test Ea, Unpackaged Shock):<br>50g |
| Emissions | CISPR 11:<br>Group 1, Class A |
| ESD Immunity | IEC 61000-4-2:<br>6kV contact discharges<br>8kV air discharges |
| Radiated RF Immunity | IEC 61000-4-3:<br>10V/m with 1kHz sine-wave 80%AM from 30MHz to 2000MHz<br>10V/m with 200Hz 50% Pulse 100%AM at 900Mhz |
| EFT/B Immunity | IEC 61000-4-4:<br>±2kV at 5kHz on signal ports |
| Surge Transient Immunity | IEC 61000-4-5:<br>±2kV line-earth(CM) on shielded ports |
| Conducted RF Immunity | IEC 61000-4-6:<br>10Vrms with 1kHz sine-wave 80%AM from 150kHz to 80MHz |
| Enclosure Type Rating | None (open-style) |
| Certifications: (when product is marked) | UL — UL Listed Industrial Control Equipment<br>CSA — CSA Certified Process Control Equipment<br>CSA — CSA Certified Process Control Equipment for Class I, Division 2 Group A,B,C,D Hazardous Locations<br>CE[6] — European Union 89/336/EEC EMC Directive, compliant with:<br>EN 50082-2; Industrial Immunity<br>EN 61326; Meas./Control/Lab., Industrial Requirements<br>EN 61000-6-2; Industrial Immunity<br>EN 61000-6-4; Industrial Emissions<br>C-Tick[5] — Australian Radiocommunications Act, compliant with:<br>AS/NZS CISPR 11; Industrial Emissions |

(1) These specifications are module filter dependent.

(2) For more information on this specification, see Appendix E.

(3) Maximum wire size will require extended housing - 1756-TBE.

(4) Use this conductor category information for planning conductor routing as described in the system level installation manual.

(5) Refer to publication 1770-4.1 *Industrial Automation Wiring and Grounding Guidelines*.

(6) See the Product Certification link at www.ab.com for Declarations of Conformity, Certificates, and other certification details.

# 1756-IF8 Specifications

| | |
|---|---|
| Number of Inputs | 8 single ended, 4 differential or 2 differential (high speed) |
| Module Location | 1756 ControlLogix Chassis |
| Backplane Current | 150mA @ 5.1V dc & 40mA @ 24V dc |
| Backplane Power | 2.33W |
| Power Dissipation within Module | 1.73W – Voltage<br>2.53W – Current |
| Thermal Dissipation | 5.9 BTU/hr. – Voltage<br>8.6 BTU/hr. – Current |
| Input Range and Resolution | +/-10.25V – 320μV/count (15 bits plus sign bipolar)<br>0-10.25V – 160μV/count (16 bits)<br>0-5.125V – 80μV/count (16 bits)<br>0-20.5mA – 0.32μA/count (16 bits) |
| Common Mode Voltage Range | +/- 10.25V (20.5V between any two input terminals) |
| Data Format | Left justified, 2s complement – Integer mode<br>IEEE 32 bit – Floating point mode |
| Input Impedance | >1megΩ – Voltage<br>249Ω – Current |
| Open Circuit Detection Time | Positive full scale reading within 5s – Differential Voltage<br>Negative full scale reading within 5s – Single-ended/Differential Current<br>Even numbered channels go to positive full scale reading within 5s, odd numbered channels go to negative full scale reading within 5s – Single-ended voltage |
| Overvoltage Protection | 30V dc – Voltage<br>8V dc – Current |
| Normal Mode Noise Rejection[1] | >80dB at 50/60Hz |
| Common Mode Noise Rejection | >100dB at 50/60Hz |
| Calibrated Accuracy | Better than 0.05% of range – Voltage<br>Better than 0.15% of range – Current |
| Calibration Interval | 12 months |
| Input Offset Drift with Temperature | 90μV/°C |
| Gain Drift with Temperature | 15 ppm/°C – Voltage<br>307.5μV/°C for +/-10.25V range; 153.8μV/°C for 0-10.25V range; 76.9μV/°C for 0-5.125V range<br>20 ppm/°C – Current<br>+/-0.41μA/°C |
| Module Error over Full Temperature Range[2] | 0.1% of range – Voltage<br>0.3% of range – Current |
| Module Conversion Method | Sigma-Delta |
| Isolation Voltage<br>User to system | <br>250V<br>100% tested at 2550 dc for 1s |
| Module Scan Time for All Channels (Sample Rate Module Filter Dependent) | 16 to 488ms – 8-point single ended<br>8 to 244ms – 4-point differential<br>5 to 122ms – 2-point differential - |
| RTB Screw Torque (Cage clamp) | 4.4 inch-pounds (0.4Nm) |
| Module Keying (Backplane) | Electronic |
| RTB Keying | User defined |
| Field Wiring Arm and Housing | 36 Position RTB (1756-TBCH or TBS6H)[3] |
| Conductors<br>Wire Size<br><br>Category | <br>#22 to #14 AWG (0.324 to 2.08 sq. mm) stranded [2]<br>3/64 inch (1.2mm) insulation maximum<br>2[4], [5] |
| Screwdriver Width for RTB | 1/8 inch (3.2mm) maximum |

| Environmental Conditions | |
|---|---|
| Operating Temperature | IEC 60068-2-1 (Test Ad, Operating Cold),<br>IEC 60068-2-2 (Test Bd, Operating Dry Heat),<br>IEC 60068-2-14 (Test Nb, Operating Thermal Shock):<br>0 to 60°C (32 to 140°F) |
| Storage Temperature | IEC 60068-2-1 (Test Ab, Un-packaged Non-operating Cold),<br>IEC 60068-2-2 (Test Bb, Un-packaged Non-operating Dry Heat),<br>IEC 60068-2-14 (Test Na, Un-packaged Non-operating Thermal Shock):<br>-40 to 85°C (-40 to 185°F) |
| Relative Humidity | IEC 60068-2-30 (Test Db, Un-packaged Non-operating Damp Heat):<br>5 to 95% non-condensing |
| Vibration | IEC 60068-2-6 (Test Fc, Operating):<br>2g @ 10-500Hz |
| Operating Shock | IEC 60068-2-27 (Test Ea, Unpackaged Shock):<br>30g |
| Non-operating Shock | IEC 60068-2-27 (Test Ea, Unpackaged Shock):<br>50g |
| Emissions | CISPR 11:<br>Group 1, Class A |
| ESD Immunity | IEC 61000-4-2:<br>6kV contact discharges<br>8kV air discharges |
| Radiated RF Immunity | IEC 61000-4-3:<br>10V/m with 1kHz sine-wave 80%AM from 30MHz to 1000MHz<br>10V/m with 200Hz 50% Pulse 100%AM at 900Mhz |
| Surge Transient Immunity | IEC 61000-4-5:<br>±2kV line-earth(CM) on shielded ports |
| Conducted RF Immunity | IEC 61000-4-6:<br>10Vrms with 1kHz sine-wave 80%AM from 150kHz to 80MHz |
| Enclosure Type Rating | None (open-style) |
| Certifications<br>(when product is marked) | UL — UL Listed Industrial Control Equipment<br>CSA — CSA Certified Process Control Equipment<br>CSA — CSA Certified Process Control Equipment for Class I, Division 2 Group A,B,C,D Hazardous Locations<br>FM — FM Approved Equipment for use in Class I Division 2 Group A,B,C,D Hazardous Locations<br>CE[6] — European Union 89/336/EEC EMC Directive, compliant with:<br>EN 50082-2; Industrial Immunity<br>EN 61326; Meas./Control/Lab., Industrial Requirements<br>EN 61000-6-2; Industrial Immunity<br>EN 61000-6-4; Industrial Emissions<br>C-Tick[6] — Australian Radiocommunications Act, compliant with:<br>AS/NZS CISPR 11; Industrial Emissions<br>EEx[6] — European Union 94/9/EEC ATEX Directive, compliant with:<br>EN 50021; Potentially Explosive Atmospheres, Protection "n" (zone 2)<br>TUV — TÜV Certified for Functional Safety<br>1oo2D (AK 1-6, SIL 1-3, according to DIN V 19250 and IEC 61508 respectively) |

(1) This specification is module filter dependent.

(2) For more information on this specification, see Appendix E.

(3) Maximum wire size requires the extended housing - 1756-TBE.

(4) Use this conductor category information for planning conductor routing as described in the system level installation manual.

(5) Refer to publication 1770-4.1 *Industrial Automation Wiring and Grounding Guidelines*.

(6) See the Product Certification link at www.ab.com for Declarations of Conformity, Certificates, and other certification details.

# 1756-IR6I Specifications

| | |
|---|---|
| Number of Inputs | 6 individually isolated channels |
| Module Location | 1756 ControlLogix Chassis |
| Backplane Current | 250mA @ 5.1V dc & 125mA @ 24V dc |
| Backplane Power | 4.25W |
| Power Dissipation within Module | 4.3W |
| Thermal Dissipation | 14.66 BTU/hr |
| Input Range | 1-487Ω, 2-1000Ω, 4-2000Ω, 8-4020Ω |
| Resolution in Ranges<br>487Ω (Actual range 0.86 - 507.9Ω)<br>1000Ω (Actual range 2.0 - 1016.5Ω)<br>2000Ω (Actual range 4.0 - 2033.9Ω)<br>4020Ω (Actual range 8.0 - 4068.4Ω) | Approximately 16 bits across each input range<br>7.7mΩ/count<br>15mΩ/count<br>30mΩ/count<br>60mΩ/count |
| Sensors Supported | Resistance 4-4020Ω<br>100, 200, 500, 1000Ω Platinum, alpha=385<br>100, 200, 500, 1000Ω Platinum, alpha=3916<br>120Ω Nickel, alpha=672<br>100, 120, 200, 500Ω Nickel, alpha=618<br>10Ω Copper |
| RTD Excitation Current (All Ranges) | 594μA |
| Data Format | Left justified, 2s complement – Integer mode<br>IEEE 32 bit – Floating point mode |
| Open Circuit Detection Time | Negative full scale reading within 5s with any combination of lost wires, except input terminal A alone. If input terminal A is lost by itself, the module reads a positive full scale reading within 5s. |
| Overvoltage Protection | 24V ac/dc maximum |
| Normal Mode Noise Rejection(1) | 60dB at 60Hz |
| Common Mode Noise Rejection | 120dB at 60Hz, 100db at 50Hz |
| Channel Bandwidth(1) | 15Hz |
| Settling Time to 5% of Full Scale(1) | <80ms |
| Calibrated Accuracy(2)<br>Typical<br>Worst case | <br>Better than 0.05% of range<br>Better than 0.1% of range |
| Calibration Interval | 12 months |
| Input Offset Drift with Temperature | 10mΩ/°C |
| Gain Drift with Temperature(2)<br>Typical<br>Worst Case | <br>50 ppm/°C<br>90 ppm/°C |
| Module Error over Full Temperature Range(2) | 0.54% of range |
| Module Scan Time for all Channels(1)<br>(Sample Rate) | 25ms minimum – Floating point mode (ohms)<br>50ms minimum – Floating point mode (temperature)<br>10ms minimum – Integer mode (ohms) |
| Module Conversion Method | Sigma-Delta |
| Isolation Voltage<br>Channel to channel<br>User to system | Optoisolated, transformer isolated<br>100% tested at 1700V dc for 1s, based on 250V ac<br>100% tested at 1700V dc for 1s, based on 250V ac |
| Module Keying (Backplane) | Electronic |
| RTB Screw Torque (NEMA) | 7-9 inch-pounds (0.8-1Nm) |
| RTB Keying | User defined mechanical keying |
| RTB and Housing | 20 Position RTB (1756-TBNH or TBSH)(3) |
| Screwdriver Blade Width for RTB | 5/16 inch (8mm) maximum |
| Conductors<br>Wire Size<br><br>Category | <br>#22 to #14 AWG (0.324 to 2.08 sq. mm) stranded(2)<br>3/64 inch (1.2mm) insulation maximum<br>2(4), (5) |

| Environmental Conditions | |
|---|---|
| Operating Temperature | IEC 60068-2-1 (Test Ad, Operating Cold),<br>IEC 60068-2-2 (Test Bd, Operating Dry Heat),<br>IEC 60068-2-14 (Test Nb, Operating Thermal Shock):<br>0 to 60°C (32 to 140°F) |
| Storage Temperature | IEC 60068-2-1 (Test Ab, Un-packaged Non-operating Cold),<br>IEC 60068-2-2 (Test Bb, Un-packaged Non-operating Dry Heat),<br>IEC 60068-2-14 (Test Na, Un-packaged Non-operating Thermal Shock):<br>-40 to 85°C (-40 to 185°F) |
| Relative Humidity | IEC 60068-2-30 (Test Db, Un-packaged Non-operating Damp Heat):<br>5 to 95% non-condensing |
| Vibration | IEC 60068-2-6 (Test Fc, Operating):<br>2g @ 10-500Hz |
| Operating Shock | IEC 60068-2-27 (Test Ea, Unpackaged Shock):<br>30g |
| Non-Operating Shock | IEC 60068-2-27 (Test Ea, Unpackaged Shock):<br>50g |
| Emissions | CISPR 11:<br>Group 1, Class A |
| ESD Immunity | IEC 61000-4-2:<br>6kV contact discharges<br>8kV air discharges |
| Radiated RF Immunity | IEC 61000-4-3:<br>10V/m with 1kHz sine-wave 80%AM from 30MHz to 1000MHz<br>10V/m with 200Hz 50% Pulse 100%AM at 900Mhz |
| EFT/B Immunity | IEC 61000-4-4:<br>±2kV at 5kHz on signal ports |
| Surge Transient Immunity | IEC 61000-4-5:<br>±2kV line-earth(CM) on shielded ports |
| Conducted RF Immunity | IEC 61000-4-6:<br>10Vrms with 1kHz sine-wave 80%AM from 150kHz to 80MHz |
| Enclosure Type Rating | None (open-style) |
| Certifications: (when product is marked) | UL UL Listed Industrial Control Equipment<br>CSA CSA Certified Process Control Equipment<br>CSA CSA Certified Process Control Equipment for Class I, Division 2 Group A,B,C,D Hazardous Locations<br>FM FM Approved Equipment for use in Class I Division 2 Group A,B,C,D Hazardous Locations<br>CE(6) European Union 89/336/EEC EMC Directive, compliant with:<br>EN 50082-2; Industrial Immunity<br>EN 61326; Meas./Control/Lab., Industrial Requirements<br>EN 61000-6-2; Industrial Immunity<br>EN 61000-6-4; Industrial Emissions<br>C-Tick(6) Australian Radiocommunications Act, compliant with:<br>AS/NZS CISPR 11; Industrial Emissions<br>EEx(6) European Union 94/9/EC ATEX Directive, compliant with:<br>EN 50021; Potentially Explosive Atmospheres, Protection "n" (Zone 2)<br>TÜV(6) TÜV Certified for Functional Safety<br>1oo2D (AK 1-6, SIL 1-3, according to DIN V 19250 and IEC 61508 respectively) |

(1) These specifications are notch filter dependent.

(2) For more information on this specification, see Appendix E.

(3) Maximum wire size will require extended housing - 1756-TBE.

(4) Use this conductor category information for planning conductor routing as described in the system level installation manual.

(5) Refer to publication 1770-4.1 *Industrial Automation Wiring and Grounding Guidelines*.

(6) See the Product Certification link at www.ab.com for Declarations of Conformity, Certificates, and other certification details.

# 1756-IT6I Specifications

| | | |
|---|---|---|
| Number of Inputs | 6 individually isolated channels | |
| Module Location | 1756 ControlLogix Chassis | |
| Backplane Current | 250mA @ 5.1V dc & 125mA @ 24V dc | |
| Backplane Power | 4.3W | |
| Power Dissipation within Module | 4.3W | |
| Thermal Dissipation | 14.66 BTU/hr. | |
| Input Ranges | -12mV to +78mV (1.4μV per bit)<br>-12mV to +30mV (0.7μV per bit – high resolution range) | |
| Supported Thermocouple Types | B, E, J, K, R, S, T, N, C | |
| Thermocouple Linearization | ITS-90 | |
| Resolution | 16 bits<br>1.4μV/bit – Typical<br>0.7μV/bit – High resolution range | |
| Data Format | Left justified, 2s complement – Integer mode<br>IEEE 32 bit – Floating point mode | |
| Input Impedance | >10MΩ | |
| Open Circuit Detection Time | Positive full scale reading within 2s | |
| Overvoltage Protection | 120V ac/dc maximum | |
| Normal Mode Noise Rejection[1] | 60dB at 60Hz | |
| Common Mode Noise Rejection | 120dB at 60Hz<br>100dB at 50Hz | |
| Channel Bandwidth[1] | 15Hz | |
| Settling Time to 5% of Full Scale[1] | <80ms | |
| Module Conversion Method | Sigma-Delta | |
| Isolation Voltage<br>Channel to channel<br>User to system | Optoisolated, transformer isolated<br>100% tested at 1700V dc for 1s, based on 250V ac<br>100% tested at 1700V dc for 1s, based on 250V ac | |
| Thermocouple Temp. and Millivolt Input Range | -12 to +78mV range | -12 to +30mV range |
| Thermocouple Type B | 300 to 1820°C | full range |
| Thermocouple Type C | 0 to 2315°C | 0 to 1725°C |
| Thermocouple Type E | -270 to 1000°C | -270 to 415°C |
| Thermocouple Type J | -210 to 1200°C | -210 to 550°C |
| Thermocouple Type K | -270 to 1372°C | -270 to 725°C |
| Thermocouple Type N | -270 to 1300°C | -270 to 840°C |
| Thermocouple Type R | -50 to 1768°C | full range |
| Thermocouple Type S | -50 to 1768°C | full range |
| Thermocouple Type T | -270 to 400°C | full range |
| Thermocouple Resolution Over Nominal Temperature Range | -12 to +78mV range | -12 to +30mV range |
| Type B, R, S, C | ~0.15°C | ~0.08°C |
| Type E, J, K, T, N | ~0.05°C | ~0.03°C |
| Calibrated Accuracy[2]<br>Typical<br>Worst case | 0.05% of full range at 25°C<br>Better than 0.1% of full range at 25°C | |
| Calibration Interval | 12 months | |
| Accuracy (Cold Junction Sensor)<br>Local CJS (RTB)<br>Remote CJS (IFM) | +/-0.3°C up to +/-3.2°C<br>+/-0.3°C | |
| Input Offset Drift with Temperature | 0.5μV/°C | |
| Gain Drift with Temperature[2]<br>Typical<br>Worst case | 65 ppm/°C (5.9μV/°C for -12 to +78mV range; 2.7μV/°C for -12 to +30mV range)<br>80 ppm/°C (7.2μV/°C for -12 to +78mV range; 3.4μV/°C for -12 to +30mV range) | |
| Module Error over Full Temperature Range[2] | 0.5% of temperature range | |
| Module Scan Time for all Channels (Sample Rate)[1] | 25ms minimum – Floating point mode (millivolt)<br>50ms minimum – Floating point mode (temperature linearization)<br>10ms minimum – Integer (millivolt) | |
| RTB Screw Torque (NEMA) | 7-9 inch-pounds (0.8-1Nm) | |
| Module Keying (Backplane) | Electronic | |

| | |
|---|---|
| RTB Keying | User defined |
| Field Wiring Arm and Housing | 20 Position RTB (1756-TBNH or TBSH)[3] |
| Conductors | |
| Wire Size | #22 to #14 AWG (0.324 to 2.08 sq. mm) stranded[3]<br>3/64 inch (1.2mm) insulation maximum |
| Category | 2[4], [5] |
| Screwdriver Width for RTB | 5/16 inch (8mm) maximum |
| Environmental Conditions | |
| Operating Temperature | IEC 60068-2-1 (Test Ad, Operating Cold),<br>IEC 60068-2-2 (Test Bd, Operating Dry Heat),<br>IEC 60068-2-14 (Test Nb, Operating Thermal Shock):<br>0 to 60°C (32 to 140°F) |
| Storage Temperature | IEC 60068-2-1 (Test Ab, Un-packaged Non-operating Cold),<br>IEC 60068-2-2 (Test Bb, Un-packaged Non-operating Dry Heat),<br>IEC 60068-2-14 (Test Na, Un-packaged Non-operating Thermal Shock):<br>-40 to 85°C (-40 to 185°F) |
| Relative Humidity | IEC 60068-2-30 (Test Db, Un-packaged Non-operating Damp Heat):<br>5 to 95% non-condensing |
| Vibration | IEC 60068-2-6 (Test Fc, Operating):<br>2g @ 10-500Hz |
| Operating Shock | IEC 60068-2-27 (Test Ea, Unpackaged Shock):<br>30g |
| Non-Operating Shock | IEC 60068-2-27 (Test Ea, Unpackaged Shock):<br>50g |
| Emissions | CISPR 11:<br>Group 1, Class A |
| ESD Immunity | IEC 61000-4-2:<br>6kV contact discharges<br>8kV air discharges |
| Radiated RF Immunity | IEC 61000-4-3:<br>10V/m with 1kHz sine-wave 80%AM from 30MHz to 1000MHz<br>10V/m with 200Hz 50% Pulse 100%AM at 900Mhz |
| EFT/B Immunity | IEC 61000-4-4:<br>±2kV at 5kHz on signal ports |
| Surge Transient Immunity | IEC 61000-4-5:<br>±2kV line-earth(CM) on shielded ports |
| Conducted RF Immunity | IEC 61000-4-6:<br>10Vrms with 1kHz sine-wave 80%AM from 150kHz to 80MHz |
| Enclosure Type Rating | None (open-style) |
| Certifications:<br>(when product is marked) | UL UL Listed Industrial Control Equipment<br>CSA CSA Certified Process Control Equipment<br>CSA CSA Certified Process Control Equipment for Class I, Division 2 Group A,B,C,D Hazardous Locations<br>FM FM Approved Equipment for use in Class I Division 2 Group A,B,C,D Hazardous Locations<br>CE[6] European Union 89/336/EEC EMC Directive, compliant with:<br>EN 50082-2; Industrial Immunity<br>EN 61326; Meas./Control/Lab., Industrial Requirements<br>EN 61000-6-2; Industrial Immunity<br>EN 61000-6-4; Industrial Emissions<br>C-Tick[6] Australian Radiocommunications Act, compliant with:<br>AS/NZS CISPR 11; Industrial Emissions<br>EEx[6] European Union 94/9/EC ATEX Directive, compliant with:<br>EN 50021; Potentially Explosive Atmospheres, Protection "n" (Zone 2)<br>TÜV[6] TÜV Certified for Functional Safety<br>1oo2D (AK 1-6, SIL 1-3, according to DIN V 19250 and IEC 61508 respectively) |

(1) These specifications are notch filter dependent. Values listed represent 60Hz setting.

(2) For more information on this specification, see Appendix E.

(3) Maximum wire size requires extended housing – 1756-TBE.

(4) Use this conductor category information for planning conductor routing as described in the system level installation manual.

(5) Refer to publication 1770-4.1 *Industrial Automation Wiring and Grounding Guidelines*.

(6) See the Product Certification link at www.ab.com for Declarations of Conformity, Certificates, and other certification details.

# 1756-IT6I2 Specifications

| | |
|---|---|
| Number of Inputs | 6 individually isolated channels |
| Module Location | 1756 ControlLogix Chassis |
| Backplane Current | 250mA @ 5.1V dc & 125mA @ 24V dc |
| Backplane Power | 4.3W |
| Power Dissipation within Module | 4.3W |
| Thermal Dissipation | 14.66 BTU/hr. |
| Input Ranges | -12mV to +78mV (1.4μV per bit)<br>-12mV to +30mV (0.7μV per bit – high resolution range) |
| Supported Thermocouple Types | B, E, J, K, R, S, T, N, C, D, L |
| Thermocouple Linearization | ITS-90 |
| Resolution | 16 bits (1.4μV/bit – Typical; 0.7μV/bit – High resolution range) |
| Data Format | Left justified, 2s complement – Integer mode<br>IEEE 32 bit – Floating point mode |
| Input Impedance | >10MΩ |
| Open Circuit Detection Time | Positive full scale reading within 2s |
| Overvoltage Protection | 120V ac/dc maximum |
| Normal Mode Noise Rejection(1) | 60dB at 60Hz |
| Common Mode Noise Rejection | 150dB at 60Hz |
| Channel Bandwidth(1) | 15Hz |
| Settling Time to 5% of Full Scale(1) | <80ms |
| Module Conversion Method | Sigma-Delta |
| Isolation Voltage<br>Channel to channel and User to system | Optoisolated, transformer isolated<br>250 V<br>100% tested at 1900V dc for 2s |
| Thermocouple Temp. and Millivolt Input Range<br>Thermocouple Type B<br>Thermocouple Type C<br>Thermocouple Type E<br>Thermocouple Type J<br>Thermocouple Type K<br>Thermocouple Type N<br>Thermocouple Type R<br>Thermocouple Type S<br>Thermocouple Type T | -12 to +78mV range / -12 to +30mV range<br>300 to 1820°C / full range<br>0 to 2315°C / 0 to 1725°C<br>-270 to 1000°C / -270 to 415°C<br>-210 to 1200°C / -210 to 550°C<br>-270 to 1372°C / -270 to 725°C<br>-270 to 1300°C / -270 to 840°C<br>-50 to 1768°C / full range<br>-50 to 1768°C / full range<br>-270 to 400°C / full range |
| Thermocouple Resolution Over Nominal Temperature Range<br>Type B, R, S, C<br>Type E, J, K, T, N | -12 to +78mV range / -12 to +30mV range<br>~0.15°C / ~0.08°C<br>~0.05°C / ~0.03°C |
| Calibrated Accuracy(2)<br>Typical<br>Worst case | 0.05% of full range at 25°C<br>Better than 0.1% of full range at 25°C |
| Calibration Interval | 12 months |
| Accuracy (Cold Junction Sensor)<br>Local or Remote CJC (RTB or IFM) | +/-0.3°C |
| Input Offset Drift with Temperature | 0.5μV/°C |
| Gain Drift with Temperature | 25 ppm/°C (2.3μV/°C for -12 to +78mV range; 1.1μV/°C for -12 to +30mV range) |
| Module Error over Full Temperature Range(2) | 0.15% of temperature range |
| Module Scan Time for all Channels (Sample Rate)(1) | 50ms minimum – Floating point mode (temperature linearization)<br>10ms minimum – Integer (millivolt) |
| RTB Screw Torque (NEMA) | 7-9 inch-pounds (0.8-1Nm) |
| Module Keying (Backplane) | Electronic |
| RTB Keying | User defined |
| Field Wiring Arm and Housing | 20 Position RTB (1756-TBNH or TBSH)(3) |

| | |
|---|---|
| Conductors | |
| Wire Size | #22 to #14 AWG (0.324 to 2.08 sq. mm) stranded[3]<br>3/64 inch (1.2mm) insulation maximum |
| Category | 2[4], [5] |
| Screwdriver Width for RTB | 5/16 inch (8mm) maximum |
| Environmental Conditions | |
| Operating Temperature | IEC 60068-2-1 (Test Ad, Operating Cold),<br>IEC 60068-2-2 (Test Bd, Operating Dry Heat),<br>IEC 60068-2-14 (Test Nb, Operating Thermal Shock):<br>0 to 60°C (32 to 140°F) |
| Storage Temperature | IEC 60068-2-1 (Test Ab, Un-packaged Non-operating Cold),<br>IEC 60068-2-2 (Test Bb, Un-packaged Non-operating Dry Heat),<br>IEC 60068-2-14 (Test Na, Un-packaged Non-operating Thermal Shock):<br>-40 to 85°C (-40 to 185°F) |
| Relative Humidity | IEC 60068-2-30 (Test Db, Un-packaged Non-operating Damp Heat):<br>5 to 95% non-condensing |
| Vibration | IEC 60068-2-6 (Test Fc, Operating):<br>2g @ 10-500Hz |
| Operating Shock | IEC 60068-2-27 (Test Ea, Unpackaged Shock):<br>30g |
| Non-Operating Shock | IEC 60068-2-27 (Test Ea, Unpackaged Shock):<br>50g |
| Emissions | CISPR 11:<br>Group 1, Class A |
| ESD Immunity | IEC 61000-4-2:<br>6kV contact discharges<br>8kV air discharges |
| Radiated RF Immunity | IEC 61000-4-3:<br>10V/m with 1kHz sine-wave 80%AM from 80MHz to 2000MHz<br>10V/m with 200Hz 50% Pulse 100%AM at 900Mhz<br>10V/m with 200Hz 50% Pulse 100%AM at 1890Mhz |
| EFT/B Immunity | IEC 61000-4-4:<br>+/-2kV at 5kHz on signal ports |
| Surge Transient Immunity | IEC 61000-4-5:<br>±2kV line-earth(CM) on shielded ports |
| Conducted RF Immunity | IEC 61000-4-6:<br>10Vrms with 1kHz sine-wave 80%AM from 150kHz to 80MHz |
| Certifications:<br>(when product is marked) | UL UL Listed Industrial Control Equipment<br>CSA CSA Certified Process Control Equipment<br>CSA CSA Certified Process Control Equipment for Class I, Division 2 Group A,B,C,D Hazardous Locations<br>FM FM Approved Equipment for use in Class I Division 2 Group A,B,C,D Hazardous Locations<br>CE[6] European Union 89/336/EEC EMC Directive, compliant with:<br>EN 50082-2; Industrial Immunity<br>EN 61326; Meas./Control/Lab., Industrial Requirements<br>EN 61000-6-2; Industrial Immunity<br>EN 61000-6-4; Industrial Emissions<br>C-Tick[6] Australian Radiocommunications Act, compliant with:<br>AS/NZS CISPR 11; Industrial Emissions |

(1) These specifications are notch filter dependent. Values listed represent 60Hz setting.

(2) For more information on this specification, see Appendix E.

(3) Maximum wire size requires extended housing – 1756-TBE.

(4) Use this conductor category information for planning conductor routing as described in the system level installation manual.

(5) Refer to publication 1770-4.1 *Industrial Automation Wiring and Grounding Guidelines*.

(6) See the Product Certification link at www.ab.com for Declarations of Conformity, Certificates, and other certification details.

# 1756-OF4 Specifications

| | |
|---|---|
| Number of Outputs | 4 voltage or current outputs |
| Module Location | 1756 ControlLogix Chassis |
| Backplane Current | 150mA @ 5.1V dc & 120mA @ 24V dc |
| Backplane Power | 5.8W |
| Power Dissipation within Module | 3.2W – 4 channel current |
| Thermal Dissipation | 10.91 BTU/hr. |
| Output Range | +/- 10.4V<br>0 to 21mA |
| Resolution | 15 bits across 10.4V - 320μV/bit – Voltage<br>15 bits across 21mA - 650nA/bit – Current |
| Data Format | Left justified, 2s complement – Integer mode<br>IEEE 32 bit – Floating point mode |
| Open Circuit Detection | Current output only (Output must be set to >0.1mA) |
| Output Overvoltage Protection | 24V dc |
| Output Short Circuit Protection | Electronically current limited to 21mA or less |
| Drive Capability | >2000Ω – Voltage<br>0-750Ω – Current |
| Output Settling Time | <2ms to 95% of final value with resistive loads |
| Calibrated Accuracy | Better than 0.05% of range from 4mA to 21mA, -10.4V to 10.4V |
| Calibration Interval | Twelve months |
| Output Offset Drift with Temperature | 50μV/°C<br>100nA/°C |
| Gain Drift with Temperature | 25 ppm/°C – Voltage<br>520μV/°C<br>50 ppm/°C – Current<br>1.05μA/°C |
| Module Error over Full Temperature Range[1] | 0.15% of range – Voltage<br>0.3% of range – Current |
| Module Scan Time for all Channels | 12ms minimum – Floating point mode<br>8ms minimum – Integer |
| Isolation Voltage<br>User to system | <br>250V<br>100% tested at 2550V dc for 1 second |
| Module Conversion Method | R-Ladder DAC, monotonicity with no missing codes |
| RTB Screw Torque (NEMA) | 7-9 inch-pounds (0.8-1Nm) |
| Module Keying (Backplane) | Electronic |
| RTB Keying | User defined |
| RTB and Housing | 20 Position RTB (1756-TBNH or TBSH)[2] |
| Conductors<br>Wire Size<br><br>Category | <br>#22 to #14 AWG (0.324 to 2.08 sq. mm) stranded[1]<br>3/64 inch (1.2mm) insulation maximum<br>2[3], [4] |
| Screwdriver Width for RTB | 5/16 inch (8mm) maximum |

| Environmental Conditions | |
|---|---|
| Operating Temperature | IEC 60068-2-1 (Test Ad, Operating Cold),<br>IEC 60068-2-2 (Test Bd, Operating Dry Heat),<br>IEC 60068-2-14 (Test Nb, Operating Thermal Shock):<br>0 to 60°C (32 to 140°F) |
| Storage Temperature | IEC 60068-2-1 (Test Ab, Un-packaged Non-operating Cold),<br>IEC 60068-2-2 (Test Bb, Un-packaged Non-operating Dry Heat),<br>IEC 60068-2-14 (Test Na, Un-packaged Non-operating Thermal Shock):<br>-40 to 85°C (-40 to 185°F) |
| Relative Humidity | IEC 60068-2-30 (Test Db, Un-packaged Non-operating Damp Heat):<br>5 to 95% non-condensing |
| Vibration | IEC60068-2-6 (Test Fc, Operating):<br>2g @ 10-500Hz |
| Operating Shock | IEC60068-2-27 (Test Ea, Unpackaged shock):<br>30g |
| Non-operating Shock | IEC60068-2-27 (Test Ea, Unpackaged shock):<br>50g |
| Emissions | CISPR 11:<br>Group 1, Class A |
| ESD Immunity | IEC 61000-4-2:<br>6kV contact discharges<br>8kV air discharges |
| Radiated RF Immunity | IEC 61000-4-3:<br>10V/m with 1kHz sine-wave 80%AM from 30MHz to 1000MHz<br>10V/m with 200Hz 50% Pulse 100%AM at 900Mhz |
| EFT/B Immunity | IEC 61000-4-4:<br>±2kV at 5kHz on signal ports |
| Surge Transient Immunity | IEC 61000-4-5:<br>±2kV line-earth (CM) on shielded ports |
| Conducted RF Immunity | IEC 61000-4-6:<br>10Vrms with 1kHz sine-wave 80%AM from 150kHz to 80MHz |
| Enclosure Type Rating | None (open-style) |
| Certifications<br>(when product is marked) | UL — UL Listed Industrial Control Equipment<br>CSA — CSA Certified Process Control Equipment<br>CSA — CSA Certified Process Control Equipment for Class I, Division 2 Group A,B,C,D Hazardous Locations<br>FM — FM Approved Equipment for use in Class I Division 2 Group A,B,C,D Hazardous Locations<br>CE(5) — European Union 89/336/EEC EMC Directive, compliant with:<br>EN 50082-2; Industrial Immunity<br>EN 61326; Meas./Control/Lab., Industrial Requirements<br>EN 61000-6-2; Industrial Immunity<br>EN 61000-6-4; Industrial Emissions<br>C-Tick(5) — Australian Radiocommunications Act, compliant with:<br>AS/NZS CISPR 11; Industrial Emissions<br>EEx(5) — European Union 94/9/EEC ATEX Directive, compliant with:<br>EN 50021; Potentially Explosive Atmospheres, Protection "n" (zone 2) |

(1) For more information on this specification, see Appendix E.

(2) Maximum wire size requires extended housing - 1756-TBE.

(3) Use this conductor category information for planning conductor routing as described in the system level installation manual.

(4) Refer to publication 1770-4.1 *Industrial Automation Wiring and Grounding Guidelines*.

(5) See the Product Certification link at www.ab.com for Declarations of Conformity, Certificates, and other certification details.

# 1756-OF6CI Specifications

| | |
|---|---|
| Number of Outputs | 6 individually isolated channels |
| Module Location | 1756 ControlLogix Chassis |
| Backplane Current<br>0-550Ω loads<br>551-1000Ω loads | <br>250mA @ 5.1V dc & 225mA @ 24V dc (load terminated on OUTs and RTNs)<br>250mA @ 5.1V dc & 300mA @ 24V dc (load terminated on OUTs and ALTs) |
| Backplane Power<br>0-550Ω loads<br>551-1000Ω loads | <br>6.7W<br>8.5W |
| Power Dissipation within Module<br>0-550Ω loads<br>551-1000Ω loads | <br>5.5W<br>6.1W |
| Thermal Dissipation<br>0-550Ω loads<br>551-1000Ω loads | <br>18.76 BTU/hr.<br>20.80 BTU/hr. |
| Output Current Range | 0 to 21mA |
| Current Resolution | 13 bits across 21mA (2.7µA) |
| Data Format | Left justified, 2s complement – Integer mode<br>IEEE 32 bit – Floating point mode |
| Open Circuit Detection | None |
| Output Overvoltage Protection | 24V ac/dc maximum |
| Output Short Circuit Protection | Electronically current limited to 21mA or less |
| Drive Capability | 0-1000Ω<br>Separate field terminations for ranges 0-550Ω or 551-1000Ω |
| Output Settling Time | <2ms to 95% of final value with resistive loads |
| Calibrated Accuracy | Better than 0.1% of range from 4mA to 21mA |
| Calibration Interval | 12 months |
| Output Offset Drift with Temperature | 1 µA/°C |
| Gain Drift with Temperature[1]<br>Typical<br>Worst case | <br>60 ppm/°C<br>1.26µA/°C<br>100 ppm/°C<br>2.10µA/°C |
| Module Error over Full Temperature Range[1] | 0.6% of range |
| Minimum Module Scan Time for All Channels | 25ms minimum – Floating point mode<br>10ms minimum – Integer mode |
| Isolation Voltage<br>Channel to channel<br>User to system | Optoisolated, transformer isolated<br>100% tested at 1700V dc for 1s, based on 250V ac<br>100% tested at 1700V dc for 1s, based on 250V ac |
| Module Conversion Method | R-Ladder DAC, monotonicity with no missing codes |
| Inductive Load | <1 mH |
| Module Keying (Backplane) | Electronic |
| RTB Screw Torque (NEMA) | 7-9 inch-pounds (0.8-1Nm) |
| RTB Keying | User defined |
| RTB and Housing | 20 Position RTB (1756-TBNH or TBSH)[2] |
| Conductors<br>Wire Size<br>Category | <br>#22 to #14 AWG (0.324 to 2.08 sq. mm) stranded[1]<br>3/64 inch (1.2mm) insulation maximum<br>2[3], [4] |
| Screwdriver Width for RTB | 5/16 inch (8mm) maximum |

| Environmental Conditions | |
|---|---|
| Operating Temperature | IEC 60068-2-1 (Test Ad, Operating Cold),<br>IEC 60068-2-2 (Test Bd, Operating Dry Heat),<br>IEC 60068-2-14 (Test Nb, Operating Thermal Shock):<br>0 to 60°C (32 to 140°F) |
| Storage Temperature | IEC 60068-2-1 (Test Ab, Un-packaged Non-operating Cold),<br>IEC 60068-2-2 (Test Bb, Un-packaged Non-operating Dry Heat),<br>IEC 60068-2-14 (Test Na, Un-packaged Non-operating Thermal Shock):<br>–40 to 85°C (–40 to 185°F) |
| Relative Humidity | IEC 60068-2-30 (Test Db, Un-packaged Non-operating Damp Heat):<br>5 to 95% non-condensing |
| Vibration | IEC60068-2-6 (Test Fc, Operating):<br>2g @ 10-500Hz |
| Operating Shock | IEC60068-2-27 (Test Ea, Unpackaged shock):<br>30g |
| Non-Operating Shock | IEC60068-2-27 (Test Ea, Unpackaged shock):<br>50g |
| Emissions | CISPR 11:<br>Group 1, Class A |
| ESD Immunity | IEC 61000-4-2:<br>6kV contact discharges<br>8kV air discharges |
| Radiated RF Immunity | IEC 61000-4-3:<br>10V/m with 1kHz sine-wave 80%AM from 30MHz to 1000MHz<br>10V/m with 200Hz 50% Pulse 100%AM at 900Mhz |
| EFT/B Immunity | IEC 61000-4-4:<br>±2kV at 5kHz on signal ports |
| Surge Transient Immunity | IEC 61000-4-5:<br>±2kV line-earth (CM) on shielded ports |
| Conducted RF Immunity | IEC 61000-4-6:<br>10Vrms with 1kHz sine-wave 80%AM from 150kHz to 80MHz |
| Enclosure Type Rating | None (open-style) |
| Certifications<br>(when product is marked) | UL — UL Listed Industrial Control Equipment<br>CSA — CSA Certified Process Control Equipment<br>CSA — CSA Certified Process Control Equipment for Class I, Division 2 Group A,B,C,D Hazardous Locations<br>FM — FM Approved Equipment for use in Class I Division 2 Group A,B,C,D Hazardous Locations<br>CE[5] — European Union 89/336/EEC EMC Directive, compliant with:<br>EN 50082-2; Industrial Immunity<br>EN 61326; Meas./Control/Lab., Industrial Requirements<br>EN 61000-6-2; Industrial Immunity<br>EN 61000-6-4; Industrial Emissions<br>C-Tick[5] — Australian Radiocommunications Act, compliant with:<br>AS/NZS CISPR 11; Industrial Emissions<br>EEx[5] — European Union 94/9/EEC ATEX Directive, compliant with:<br>EN 50021; Potentially Explosive Atmospheres, Protection "n" (zone 2) |

(1) For more information on this specification, see Appendix E.

(2) Maximum wire size will require extended housing - 1756-TBE.

(3) Use this conductor category information for planning conductor routing as described in the system level installation manual.

(4) Refer to publication 1770-4.1 *Industrial Automation Wiring and Grounding Guidelines.*

(5) See the Product Certification link at www.ab.com for Declarations of Conformity, Certificates, and other certification details.

# 1756-OF6VI Specifications

| | |
|---|---|
| Number of Outputs | 6 individually isolated channels |
| Module Location | 1756 ControlLogix Chassis |
| Backplane Current | 250mA @ 5.1V dc & 175mA @ 24V dc |
| Backplane Power | 5.5W |
| Power Dissipation within Module | 4.85W |
| Thermal Dissipation | 16.54 BTU/hr |
| Output Voltage Range | +/- 10.5V maximum |
| Voltage Resolution | 14 bits across 21V (1.3mV)<br>(13 bits across 10.5V +sign bit) |
| Data Format | Left justified, 2s complement – Integer mode<br>IEEE 32 bit – Floating point mode |
| Output Impedance | <1Ω |
| Open Circuit Detection | None |
| Output Overvoltage Protection | 24V ac/dc maximum |
| Output Short Circuit Protection | Electronically current limited |
| Drive Capability | ≥1000Ω loads, 10mA maximum |
| Output Settling Time | <2ms to 95% of final value with resistive loads |
| Calibrated Accuracy(1) | Better than 0.1% of range |
| Calibration Interval | 12 months |
| Output Offset Drift with Temperature | 60 µV/°C |
| Gain Drift with Temperature(1)<br>Typical<br>Worst case | <br>50 ppm/°C<br>1.05mV/°C<br>80 ppm/°C<br>1.68mV/°C |
| Module Error over Full Temperature Range(1) | 0.5% of range |
| Minimum Module Scan Time for all Channels | 25ms minimum – Floating point mode<br>10ms minimum – Integer mode |
| Isolation Voltage<br>Channel to channel<br>User to system | Optoisolated, transformer isolated<br>100% tested at 1700V dc for 1s, based on 250V ac<br>100% tested at 1700V dc for 1s, based on 250V ac |
| Module Conversion Method | R-Ladder DAC, monotonicity with no missing codes |
| Capacitive Load | <1 µF |
| Module Keying (Backplane) | Electronic |
| RTB Screw Torque (NEMA) | 7-9 inch-pounds (0.8-1Nm) |
| RTB Keying | User defined |
| RTB and Housing | 20 Position RTB (1756-TBNH or TBSH)(2) |
| Conductors<br>Wire Size<br>Category | <br>#22 to #14 AWG (0.324 to 2.08 sq. mm) stranded(1)<br>3/64 inch (1.2mm) insulation maximum<br>2(3), (4) |
| Screwdriver Width for RTB | 5/16 inch (8mm) maximum |

| Environmental Conditions | |
|---|---|
| Operating Temperature | IEC 60068-2-1 (Test Ad, Operating Cold),<br>IEC 60068-2-2 (Test Bd, Operating Dry Heat),<br>IEC 60068-2-14 (Test Nb, Operating Thermal Shock):<br>0 to 60°C (32 to 140°F) |
| Storage Temperature | IEC 60068-2-1 (Test Ab, Un-packaged Non-operating Cold),<br>IEC 60068-2-2 (Test Bb, Un-packaged Non-operating Dry Heat),<br>IEC 60068-2-14 (Test Na, Un-packaged Non-operating Thermal Shock):<br>–40 to 85°C (–40 to 185°F) |
| Relative Humidity | IEC 60068-2-30 (Test Db, Un-packaged Non-operating Damp Heat):<br>5 to 95% non-condensing |
| Vibration | IEC 60068-2-6 (Test Fc, Operating):<br>2g @ 10-500Hz |
| Shock | IEC 60068-2-27 (Test Ea, Unpackaged shock):<br>30g |
| Non-Operating Shock | IEC 60068-2-27 (Test Ea, Unpackaged shock):<br>50g |
| Emissions | CISPR 11:<br>Group 1, Class A |
| ESD Immunity | IEC 61000-4-2:<br>6kV contact discharges<br>8kV air discharges |
| Radiated RF Immunity | IEC 61000-4-3:<br>10V/m with 1kHz sine-wave 80%AM from 30MHz to 1000MHz<br>10V/m with 200Hz 50% Pulse 100%AM at 900Mhz |
| EFT/B Immunity | IEC 61000-4-4:<br>±2kV at 5kHz on signal ports |
| Surge Transient Immunity | IEC 61000-4-5:<br>±2kV line-earth (CM) on shielded ports |
| Conducted RF Immunity | IEC 61000-4-6:<br>10Vrms with 1kHz sine-wave 80%AM from 150kHz to 80MHz |
| Enclosure Type Rating | None (open-style) |
| Certifications<br>(when product is marked) | UL — UL Listed Industrial Control Equipment<br>CSA — CSA Certified Process Control Equipment<br>CSA — CSA Certified Process Control Equipment for Class I, Division 2 Group A,B,C,D Hazardous Locations<br>FM — FM Approved Equipment for use in Class I Division 2 Group A,B,C,D Hazardous Locations<br>CE[5] — European Union 89/336/EEC EMC Directive, compliant with:<br>EN 50082-2; Industrial Immunity<br>EN 61326; Meas./Control/Lab., Industrial Requirements<br>EN 61000-6-2; Industrial Immunity<br>EN 61000-6-4; Industrial Emissions<br>C-Tick[5] — Australian Radiocommunications Act, compliant with:<br>AS/NZS CISPR 11; Industrial Emissions<br>EEx[5] — European Union 94/9/EEC ATEX Directive, compliant with:<br>EN 50021; Potentially Explosive Atmospheres, Protection "n" (zone 2) |

(1) For more information on this specification, see Appendix E.

(2) Maximum wire size will require extended housing - 1756-TBE.

(3) Use this conductor category information for planning conductor routing as described in the system level installation manual.

(4) Refer to publication 1770-4.1 *Industrial Automation Wiring and Grounding Guidelines*.

(5) See the Product Certification link at www.ab.com for Declarations of Conformity, Certificates, and other certification details.

# 1756-OF8 Specifications

| | |
|---|---|
| Number of Outputs | 8 voltage or current outputs |
| Module Location | 1756 ControlLogix Chassis |
| Backplane Current | 150mA @ 5.1V dc & 210mA @ 24V dc |
| Backplane Power | 5.8W |
| Power Dissipation within Module | 4.92W - 8 channel current |
| Thermal Dissipation | 16.78 BTU/hr. |
| Output Range | +/- 10.4V<br>0 to 21mA |
| Resolution | 15 bits across 10.4V - 320μV/bit – Voltage<br>15 bits across 21mA - 650nA/bit – Current |
| Data Format | Left justified, 2s complement – Integer mode<br>IEEE 32 bit – Floating point mode |
| Open Circuit Detection | Current output only (Output must be set to >0.1mA) |
| Output Overvoltage Protection | 24V dc |
| Output Short Circuit Protection | Electronically current limited to 21mA or less |
| Drive Capability | >2000Ω – Voltage<br>0-750Ω – Current |
| Output Settling Time | <2ms to 95% of final value with resistive loads |
| Calibrated Accuracy[1] | Better than 0.05% of range from 4mA to 21mA, -10.4V to 10.4V |
| Calibration Interval | Twelve months – Typical |
| Output Offset Drift with Temperature | 50 μV/°C – Voltage<br>100nA/°C – Current |
| Gain Drift with Temperature | 25 ppm/°C – Voltage<br>520μV/°C<br>50 ppm/°C – Current<br>1.05μA/°C |
| Module Error over Full Temperature Range[1] | 0.15% of range – Voltage<br>0.3% of range – Current |
| Module Scan Time for all Channels | 12ms minimum – Floating point mode<br>8ms minimum – Integer |
| Isolation Voltage<br>User to system | <br>250V<br>100% tested at 2550V dc for 1 second |
| Module Conversion Method | R-Ladder DAC, monotonicity with no missing codes |
| RTB Screw Torque (NEMA) | 7-9 inch-pounds (0.8-1Nm) |
| Module Keying (Backplane) | Electronic |
| RTB Keying | User defined |
| RTB and Housing | 20 Position RTB (1756-TBNH or TBSH)[2] |

| Environmental Conditions | |
|---|---|
| Operating Temperature | IEC 60068-2-1 (Test Ad, Operating Cold),<br>IEC 60068-2-2 (Test Bd, Operating Dry Heat),<br>IEC 60068-2-14 (Test Nb, Operating Thermal Shock):<br>0 to 60°C (32 to 140°F) |
| Storage Temperature | IEC 60068-2-1 (Test Ab, Un-packaged Non-operating Cold),<br>IEC 60068-2-2 (Test Bb, Un-packaged Non-operating Dry Heat),<br>IEC 60068-2-14 (Test Na, Un-packaged Non-operating Thermal Shock):<br>–40 to 85°C (–40 to 185°F) |
| Relative Humidity | IEC 60068-2-30 (Test Db, Un-packaged Non-operating Damp Heat):<br>5 to 95% non-condensing |
| Vibration | IEC60068-2-6 (Test Fc, Operating):<br>2g @ 10-500Hz |
| Shock | IEC60068-2-27 (Test Ea, Unpackaged shock):<br>Operating 30g<br>Non-operating 50g |
| Emissions | CISPR 11:<br>Group 1, Class A |
| ESD Immunity | IEC 61000-4-2:<br>6kV contact discharges<br>8kV air discharges |
| Radiated RF Immunity | IEC 61000-4-3:<br>10V/m with 1kHz sine-wave 80%AM from 30MHz to 1000MHz<br>10V/m with 200Hz 50% Pulse 100%AM at 900Mhz |
| EFT/B Immunity | IEC 61000-4-4:<br>±2kV at 5kHz on signal ports |
| Surge Transient Immunity | IEC 61000-4-5:<br>±2kV line-earth (CM) on shielded ports |
| Conducted RF Immunity | IEC 61000-4-6:<br>10Vrms with 1kHz sine-wave 80%AM from 150kHz to 80MHz |
| Enclosure Type Rating | None (open-style) |
| Conductors<br>Wire Size<br><br>Category | <br>#22 to #14 AWG (0.324 to 2.08 sq. mm) stranded(1)<br>3/64 inch (1.2mm) insulation maximum<br>2(3), (4) |
| Screwdriver Width for RTB | 5/16 inch (8mm) maximum |
| Certifications<br>(when product is marked) | UL — UL Listed Industrial Control Equipment<br>CSA — CSA Certified Process Control Equipment<br>CSA — CSA Certified Process Control Equipment for Class I, Division 2 Group A,B,C,D Hazardous Locations<br>FM — FM Approved Equipment for use in Class I Division 2 Group A,B,C,D Hazardous Locations<br>CE(5) — European Union 89/336/EEC EMC Directive, compliant with:<br>EN 50082-2; Industrial Immunity<br>EN 61326; Meas./Control/Lab., Industrial Requirements<br>EN 61000-6-2; Industrial Immunity<br>EN 61000-6-4; Industrial Emissions<br>C-Tick(4) — Australian Radiocommunications Act, compliant with:<br>AS/NZS 2064; Industrial Emissions<br>EEx(4) — European Union 94/9/EEC ATEX Directive, compliant with:<br>EN 50021; Potentially Explosive Atmospheres, Protection “n” |

(1) For more information on this specification, see Appendix E.

(2) Maximum wire size requires extended housing - 1756-TBE.

(3) Use this conductor category information for planning conductor routing as described in the system level installation manual.

(4) Refer to publication 1770-4.1 *Industrial Automation Wiring and Grounding Guidelines*.

(5) See the Product Certification link at www.ab.com for Declarations of Conformity, Certificates, and other certification details.

## Notes:

# Tag Definitions

## Communications Mode Tag Names and Definitions

The set of tags associated with any module depends on the module type and the communications format. For each operational mode, integer or floating point, there are three sets of tags:

- input
- output
- configuration.

### Integer Mode Tags

Table B.1, Table B.2 and Table B.3 list the tags that are available on ControlLogix analog modules operating in integer mode.

**IMPORTANT** Each application's series of tags varies but no input module application contains any tags that are not listed here.

*Integer Input Tags*

**Table B.1 Integer Input Tags**

| Tag Name | Data Type | Applicable Modules | Definition: |
|---|---|---|---|
| ChannelFaults | INT | All | Collection of individual channel fault bits in one word. Can address individual channel fault via bit notation: ex. ChannelFaults 3 for channel 3 |
| Ch0Fault | BOOL | All | Individual channel fault status bit. Indicates a "hard" fault has occurred on the channel which means: calibration is ongoing; or if an input, an overrange or underrange condition is present; or if an output, a low or high clamp condition is occurring. These bits are also set by the controller if communications are lost with the I/O module. |
| ModuleFaults | INT | All | Collection of all module level fault bits |
| AnalogGroupFault | BOOL | All | Indicates if a channel fault has occurred on any channel |
| InGroupFault | BOOL | All inputs | Indicates if a channel fault has occurred on any input channel |
| Calibrating | BOOL | All | Indicates if a calibration is currently in progress on any channel |
| CalFault | BOOL | All | Status bit indicating if any channel has a "bad" calibration. "Bad" calibration means the last attempt to calibrate the channel failed with an error |
| CJUnderrange | BOOL | 1756-IT6I and 1756-IT6I2 | Status bit to indicate if the Cold Junction reading is currently beneath the lowest detectable temperature of 0.0 degrees Celsius |

**Table B.1 Integer Input Tags**

| Tag Name | Data Type | Applicable Modules | Definition: |
|---|---|---|---|
| CJOverrange | BOOL | 1756-IT6I and 1756-IT6I2 | Status bit to indicate if the Cold Junction reading is currently above the highest detectable temperature of 86.0 degrees Celsius |
| ChannelStatus | INT | All | Collection of individual channel status bits |
| Ch0Underrange | BOOL | All inputs | Alarm bits indicating the channel's input is less than the minimum detectable input signal |
| Ch0Overrange | BOOL | All inputs | Alarms bit indicating the channel's input is greater than the maximum detectable input signal |
| Ch0Data | INT | All inputs | The channel input signal represented in counts where -32,768 counts is the minimum detectable input signal and 32,767 counts is the maximum detectable |
| CJData | INT | 1756-IT6I and 1756-IT6I2 | The cold junction sensor temperature in counts where -32,768 counts is 0 degree Celsius and 32,767 counts is 86 degrees Celsius |
| CSTTimestamp | Array of DINT | All (if the CST connection is selected) | Timestamp taken at time the input data was sampled, or if an output when the output was applied, and placed in terms of Coordinated System Time which is a 64 bit quantity in microseconds coordinated across the rack. Must be addressed in 32 bit chunks as an array |
| RollingTimestamp | INT | All | Timestamp taken at time the input data was sampled, or if an output when the output was applied, which is in terms of milliseconds relative solely to the individual module |

*Integer Output Tags.*

**Table B.2 Integer Output Tags**

| Tag Name | Data Type | Applicable Modules | Definition: |
|---|---|---|---|
| Ch0Data | INT | All outputs | The value the channel is to output in counts where the minimum producible output is -32,768 counts and 32,767 counts is the maximum producible |
| Ch0DataEcho | INT | All outputs | The value the channel is currently outputting in counts where -32,768 counts is the minimum producible output signal and 32, 767 counts is the maximum producible |
| OutGroupFault | BOOL | All outputs | Indicates if a channel fault has occurred on any output channel |
| Ch0InHold | BOOL | All outputs | Bit which indicates if the output channel is currently holding until the Output value sent to the module (O tag Ch0Data) matches the current output value (I tag Ch0Data) within 0.1% of the channel's full scale |

*Integer Configuration Tags*

**Table B.3 Integer Configuration Tags**

| Tag Name | Data Type | Applicable Modules | Definition |
|---|---|---|---|
| CJDisable | BOOL | All inputs (only used for the 1756-IT6I and 1756-IT6I2) | Disables the cold junction sensor which turns off cold junction compensation when linearizing thermocouple inputs |
| RealTimeSample | INT | All input | Determines how often the input signal is to be sampled in terms of milliseconds |
| Ch0RangeNotch | SINT | 1756-IF6CIS, 1756-IF6I, 1756-IR6I, 1756-IT6I and 1756-IT6I2 | Configures the channel's input range and notch filter settings. The input range is the upper nibble (bits 4-7) and determines the signal range the input channel can detect. Input range values are as follows:<br><br>0 = -10 to 10V (1756-IF6I)<br>1 = 0 to 5V (1756-IF6I)<br>2 = 0 to 10V (1756-IF6I)<br>3 = 0 to 20mA (1756-IF6CIS and 1756-IF6I)<br>4 = -12 to 78mV (1756-IT6I and 1756-IT6I2)<br>5 = -12 to 30mV (1756-IT6I and 1756-IT6I2)<br>6 = 1 to 487Ω (1756-IR6I)<br>7 = 2 to 1,000Ω (1756-IR6I)<br>8 = 4 to 2,000Ω (1756-IR6I)<br>9 = 8 to 4,020Ω (1756-IR6I)<br><br>The notch filter provides superior frequency filtering at the selected value and its harmonics. The notch filter is the lowest nibble (bits 0-3)<br><br>0 = 10Hz<br>1 = 50Hz<br>2 = 60Hz<br>3 = 100Hz<br>4 = 250Hz<br>5 = 1,000Hz |
| ProgToFaultEn | BOOL | All outputs | The program to fault enable bit determines how the outputs should behave if a communications fault were to occur while the output module is in the program mode. When set the bit will cause the outputs to transition to their programmed fault state if a communications fault occurs while in the program state. If not set, outputs will remain in their configured program state despite a communications fault occurring |
| Ch0Config | SINT | All outputs | Contains all individual configuration bits for channel |

**Table B.3 Integer Configuration Tags**

| Tag Name | Data Type | Applicable Modules | Definition |
|---|---|---|---|
| Ch0HoldForInit | BOOL | All outputs | When set configures the channel to hold, or not change, until initialized with a value within 0.1% of full scale of its current value when one of the following conditions occurs:<br><br>1 = Module initial connection (power up)<br>2 = Module transition from Program mode back to Run mode<br>3 = Module reestablishes communications after fault |
| Ch0Fault Mode | BOOL | All outputs | Selects the behavior the output channel should take if a communications fault were to occur. Either hold last state (0) or go to a user defined value (1). Ch0FaultValue defines the value to go to on fault if the bit is set |
| Ch0ProgMode | BOOL | All outputs | Selects the behavior the output channel when transitioned into Program mode. Either hold last state (0) or go to a user defined value (1). Ch0ProgValue defines the value to go to on fault if the bit is set |
| Ch0RampToProg | BOOL | All outputs | Enables ramping of the output value to a user defined program value, Ch0ProgValue, when set. Ramping defines the maximum rate the output is allowed to transition at based upon the configured Ch0RampRate |
| Ch0RampToFault | BOOL | All outputs | Enables ramping of the output value to a user defined fault value, Ch0FaultValue, when set. Ramping defines the maximum rate the output is allowed to transition at based upon the configured Ch0RampRate |
| Ch0FaultValue | INT | All outputs | Defines the value, in counts, the output should take on if a communications fault occurs when the Ch0FaultMode bit it set |
| Ch0ProgValue | INT | All outputs | Defines the value, in counts, the output should take on when the connection transitions to Program mode if the Ch0ProgMode bit is set |
| Ch0RampRate | INT | All outputs | Configures the maximum rate at which the output value may change when transitioning to either the Ch0FaultValue or Ch0ProgValue if either the Ch0RampToFault or Ch0RampToProg bits are set respectively. In terms of percent full-scale per second |

## Floating Point Mode Tags

Table B.4, Table B.5 and Table B.3 list the tags that are available on ControlLogix analog modules operating in floating point mode.

**IMPORTANT** Each application's series of tags varies but no input module application contains any tags that are not listed here.

*Floating Point Input Tags*

**Table B.4 Floating Point Input Tags**

| Tag Name | Data Type | Applicable Modules | Definition: |
|---|---|---|---|
| ChannelFaults | INT | All | Collection of individual channel fault bits in one word. Can address individual channel fault via bit notation: ex. ChannelFaults 3 for channel 3 |
| Ch0Fault | BOOL | All | Individual channel fault status bit. Indicates a "hard" fault has occurred on the channel which means: calibration is ongoing; or if an input, an overrange or underrange condition is present; or if an output, a low or high clamp condition is occurring. These bits are also set by the controller if communications are lost with the I/O module. |
| ModuleFaults | INT | All | Collection of all module level fault bits |
| AnalogGroupFault | BOOL | All | Indicates if a channel fault has occurred on any channel |
| InGroupFault | BOOL | All inputs | Indicates if a channel fault has occurred on any input channel |
| Calibrating | BOOL | All | Indicates if a calibration is currently in progress on any channel |
| CalFault | BOOL | All | Status bit indicating if any channel has a "bad" calibration. "Bad" calibration means the last attempt to calibrate the channel failed with an error and was aborted |
| CJUnderrange | BOOL | 1756-IT6I and 1756-IT6I2 | Status bit to indicate if the Cold Junction reading is currently beneath the lowest detectable temperature of 0.0 degrees Celsius |
| CJOverrange | BOOL | 1756-IT6I and 1756-IT6I2 | Status bit to indicate if the Cold Junction reading is currently above the highest detectable temperature of 86.0 degrees Celsius |
| Ch0Status | INT | All | Collection of individual channel status bits |
| Ch0CalFault | BOOL | All inputs | Status bit indicating if the channel has a "bad" calibration. "Bad" calibration means the last attempt to calibrate the channel failed with an error and was aborted |
| Ch0Underrange | BOOL | All inputs | Alarm bits indicating the channel's input is less than the minimum detectable input signal |

**Table B.4 Floating Point Input Tags**

| Tag Name | Data Type | Applicable Modules | Definition: |
|---|---|---|---|
| Ch0Overrange | BOOL | All inputs | Alarms bit indicating the channel's input is greater than the maximum detectable input signal |
| Ch0RateAlarm | BOOL | All inputs | Alarm bit which sets when the input channel's rate of change exceeds the configured Ch0ConfigRateAlarmLimit. Remains set until the rate change drops below the configured limit unless latched via Ch0ConfigRateAlarmLatch in the configuration |
| Ch0LAlarm | BOOL | All inputs | Low alarm bits which sets when the input signal moves beneath the configured low alarm trigger point, Ch0ConfigLAlarmLimit. Remains set until the input signal moves above the trigger point, unless latched via Ch0ConfigProcAlarmLatch or the input is still within the configured alarm deadband, Ch0ConfigAlmDeadband, of the low alarm trigger point |
| Ch0HAlarm | BOOL | All inputs | High alarm bit which sets when the input signal moves above the configured high alarm trigger point, Ch0ConfigHAlarmLimit. Remains set until the input signal moves below the trigger point, unless latched viaCh0ConfigProcAlarmLatch or the input is still within the configured alarm deadband, Ch0ConfigAlmDeadband, of the high alarm trigger point |
| Ch0LLAlarm | BOOL | All inputs | Low low alarm bit which sets when the input signal moves beneath the configured low low alarm trigger point, Ch0ConfigLLAlarmLimit. Remains set until the input signal moves above the trigger point, unless latched via Ch0ConfigProcAlarmLatch or the input is still within the configured alarm deadband, Ch0ConfigAlmDeadband, of the low low alarm trigger point |
| CH0HHAlarm | BOOL | All inputs | High high alarm bit which sets when the input signal moves above the configured high high alarm trigger point, Ch0ConfigProcAlarmLimit. Remains set until the input signal moves below the trigger point, unless latched via Ch0ConfigAlmDeadband, of the high high alarm trigger point |
| Ch0Data | REAL | All inputs | The channel input signal represented in engineering units. The input signal is measured and then scaled based on the user configuration |
| CJData | REAL | 1756-IT6I and 1756-IT6I2 | The cold junction sensor temperature in degrees Celsius or Fahrenheit |
| CSTTimestamp | Array of DINT | All (if the CST connection is selected) | Timestamp taken at time the input data was sampled, or if an output when the output was applied, and placed in terms of Coordinated System Time which is a 64 bit quantity in microseconds coordinated across the rack. Must be addressed in 32 bit chunks as an array |
| RollingTimestamp | INT | All inputs | Timestamp taken at time the input data was sampled, or if an output when the output was applied, which is in terms of milliseconds relative solely to the individual module |

*Floating Point Output Tags*

**Table B.5 Floating Point Output Tags**

| Tag Name | Data Type | Applicable Modules | Definition: |
|---|---|---|---|
| Ch0Data | REAL | All outputs | The value the channel is set to output in engineering units based upon the configured scaling for the channel |
| Ch0DataEcho | REAL | All outputs | The value the channel is currently outputting in engineering units based upon the configured user scaling. Will match the requested output value, O tag Ch0Data, unless: in Program mode, calibrating, beneath Low Limit, above High Limit, currently ramping or In Hold |
| OutGroupFault | BOOL | All outputs | Indicates if a channel fault has occurred on any output channel |
| Ch0NotANumber | BOOL | All outputs | Bit indicating the received output value from the controller, O tag Ch0Data, was an invalid IEEE floating point value. When an invalid value is received, the output value holds its last known valid state |
| Ch0InHold | BOOL | All outputs | Bit which indicates if the output channel is currently holding until the Output value sent to the module (O tag Ch0Data) matches the current output value (I tag Ch0Data) within 0.1% of the channel's full scale |
| CH0RampAlarm | BOOL | All outputs | Alarm bit which sets when the requested output value, Ch0ConfigRampToRun set, and the difference between the new output value requested and the current output exceeds the configured ramp limit, Ch0ConfigMaxRampRate. The bit will remain set until ramping ceases unless the alarm is latched via Ch0ConfigRampAlarmLatch |
| Ch0LLimitAlarm | BOOL | All outputs | Alarm bit which sets when the requested output value, Ch0Data, is below the configured low limit, Ch0ConfigLowLimit, in which case the output will stop at the configured low limit which the echo will reflect. Remains set until the requested output moves above the low limit unless latched by Ch0ConfigLimitAlarmLatch |
| Ch0HLimitAlarm | BOOL | All outputs | Alarm bit which sets when the requested output value, Ch0Data, is above the configured high limit, Ch0ConfigHighLimit, in which case the output will stop at the configured high limit which the echo will reflect. Remains set until the requested output moves below the high limit unless latched by Ch0ConfigLimitAlarmLatch |

*Floating Point Configuration Tags*

**Table B.6 Floating Point Configuration Tags**

| Tag Name | Data Type | Applicable Modules | Definition |
|---|---|---|---|
| RemoteTermination | BOOL | 1756-IT6I and 1756-IT6I2 | Indicates if the cold junction sensor is mounted on a remote termination block when set, rather than on the local terminal block. Needed for proper cold junction compensation when linearizing thermocouples |
| CJDisable | BOOL | 1756-IT6I and 1756-IT6I2 | Disables the cold junction sensor which turns off cold junction compensation when linearizing thermocouple inputs |
| TempMode | BOOL | 1756-IR6I, 1756-IT6I and 1756-IT6I2 | Controls the temperature scale to use on the module:<br><br>0 = Celsius<br>1 = Fahrenheit |
| ProgToFaultEn | BOOL | All outputs | The program to fault enable bit determines how the outputs should behave if a communications fault were to occur while the output module is in the program mode. When set, the bit will cause the outputs to transition to their programmed fault state if a communications fault occurs while in the program state. If not set, outputs will remain in their configured program state despite a communications fault occurring |
| RealTimeSample | INT | All input | Determines how often the input signal is to be sampled in terms of milliseconds |
| CJOffset | REAL | 1756-IT6I and 1756-IT6I2 | Provides a user selected offset to add into the read cold junction sensor value. Allows a sensor with a built in bias to be compensated for |
| Ch0Config | Struct | All | Master structure beneath which the channel's configuration parameters are set. |

**Table B.6 Floating Point Configuration Tags**

| Tag Name | Data Type | Applicable Modules | Definition |
|---|---|---|---|
| Ch0Config RangeTypeNotch | INT | 1756-IF6CIS, 1756-IF6I, 1756-IR6I, 1756-IT6I and 1756-IT6I2 | Configures the channel's input range, sensor type and notch filter settings. The input range is bits 8-11 and determines the signal range the input channel can detect. Input range values are as follows:<br><br>0 = -10 to 10V (1756-IF6I)<br>1 = 0 to 5V (1756-IF6I)<br>2 = 0 to 10V (1756-IF6I)<br>3 = 0 to 20mA (1756-IF6CIS and 1756-IF6I)<br>4 = -12 to 78mV (1756-IT6I and 1756-IT6I2)<br>5 = -12 to 30mV (1756-IT6I and 1756-IT6I2)<br>6 = 1 to 487Ω (1756-IR6I)<br>7 = 2 to 1,000Ω (1756-IR6I)<br>8 = 4 to 2,000Ω (1756-IR6I)<br>9 = 8 to 4,020Ω (1756-IR6I)<br><br>Sensor type is bits 4-7 and selects the sensor type to use for linearization on the 1756-IR6I, IT6I. Sensor types values are as follows:<br><br>0 =no linearization, Ω (1756-IR6I), mV (1756-IT6I and 1756-IT6I2)<br>1 = 100Ω Platinum 385 (1756-IR6I) B (1756-IT6I and 1756-IT6I2)<br>2 = 200Ω Platinum 385 (1756-IR6I), C (1756-IT6I and 1756-IT6I2)<br>3 = 500Ω Platinum 385 (1756-IR6I), E (1756-IT6I and 1756-IT6I2)<br>4 = 1000Ω Platinum 385 (1756-IR6I), J (1756-IT6I and 1756-IT6I2)<br>5 = 100Ω Platinum 3916 (1756-IR6I), K (1756-IT6I and 1756-IT6I2)<br>6 = 200Ω Platinum 3916 (1756-IR6I), N (1756-IT6I and 1756-IT6I2)<br>7 = 500Ω Platinum 3916 (1756-IR6I), R (1756-IT6I and 1756-IT6I2)<br>8 = 1000Ω Platinum 3916 (1756-IR6I), S (1756-IT6I and 1756-IT6I2)<br>9 = 10Ω Copper 427 (1756-IR6I), T (1756-IT6I and 1756-IT6I2)<br>10 = 120Ω Nickel 672 (1756-IR6I), TXK/XK (L) (1756-IT6I2)<br>11 = 100Ω Nickel 618 (1756-IR6I), D (1756-IT6I2)<br>12 = 120Ω Nickel 618 (1756-IR6I)<br>13 = 200Ω Nickel 618 (1756-IR6I)<br>14 = 500Ω Nickel 618 (1756-IR6I)<br><br>The notch filter provides superior frequency filtering at the selected value and its harmonics. The notch filter is the lower nibble (bits 0-3)<br><br>0 = 10Hz<br>1 = 50Hz<br>2 = 60Hz<br>3 = 100Hz<br>4 = 250Hz<br>5 = 1,000Hz |
| Ch0ConfigAlarm Disable | BOOL | All | Disables all alarms for the channel |
| Ch0ConfigProcess AlarmLatch | BOOL | All inputs | Enables latching for all four process alarms: low, low low, high and high high. Latching causes the process alarm to remain set until an unlatch service is explicitly sent to the channel or alarm |
| Ch0ConfigRate AlarmLatch | BOOL | All inputs | Enables latching for the rate alarm. Latching causes the rate alarm to remain set until an unlatch service is explicitly sent to the channel or alarm |
| Ch0ConfigDigital Filter | INT | All inputs | A non-zero value enables the filter, providing a time constant in milliseconds used in a first order lag filter to smooth the input signal |

**Table B.6 Floating Point Configuration Tags**

| Tag Name | Data Type | Applicable Modules | Definition |
|---|---|---|---|
| Ch0ConfigTenOhm Offset | INT | 1756-IR6I | A value from -100 to 100 which represents -1.00 to 1.00Ω and is an offset used when linearizing a 10Ω copper sensor type's input |
| Ch0ConfigRate AlarmLimit | INT | All inputs | The trigger point for the rate alarm status bit which will set if the input signal changes at a rate faster than the configured rate alarm. Configured in percent full scale per second |
| Ch0ConfigLow Signal | REAL | All | One of four points used in scaling. The low signal is in terms of the inputs signal units and corresponds to the low engineering term when scaled. The scaling equation is as follows: $Data = \frac{(Signal - Low\ Signal) \times (High\ Engineering - Low\ Engineering)}{(High\ Signal - Low\ Signal)} + LowEngineering$ |
| Ch0ConfigHigh Signal | REAL | All | One of four points used in scaling. The high signal is in terms of the inputs signal units and corresponds to the high engineering term when scaled. The scaling equation is as follows: $Data = \frac{(Signal - Low\ Signal) \times (High\ Engineering - Low\ Engineering)}{(High\ Signal - Low\ Signal)} + LowEngineering$ |
| Ch0ConfigLow Engineering | REAL | All | One of four points used in scaling. The low engineering helps determine the engineering units the signal values scale into. The low engineering term corresponds to the low signal value. The scaling equation used is: $Data = \frac{(Signal - Low\ Signal) \times (High\ Engineering - Low\ Engineering)}{(High\ Signal - Low\ Signal)} + LowEngineering$ |
| C0ConfigHigh Engineering | REAL | All | One of four points used in scaling. The high engineering helps determine the engineering units the signal values scale into. The high engineering term corresponds to the high signal value. The scaling equation used is: $Data = \frac{(Signal - Low\ Signal) \times (High\ Engineering - Low\ Engineering)}{(High\ Signal - Low\ Signal)} + LowEngineering$ |
| Ch0ConfigLAlarm Limit | REAL | All inputs | The low alarm trigger point. Causes the Ch0LAlarm to trigger when the input signal moves beneath the configured trigger point. In terms of engineering units |
| Ch0ConfigHAlarm Limit | REAL | All inputs | The high alarm trigger point. Causes the Ch0HAlarm to trigger when the input signal moves above the configured trigger point. In terms of engineering units |
| Ch0ConfigLLAlarm Limit | REAL | All inputs | The low low alarm trigger point. Causes the Ch0LLAlarm to trigger when the input signal moves beneath the configured trigger point. In terms of engineering units |
| Ch0ConfigHH AlarmLimit | REAL | All inputs | The high high alarm trigger point. Causes the Ch0HHAlarm to trigger when the input signal moves above the configured trigger point. In terms of engineering units |
| Ch0ConfigAlarm Deadband | REAL | All inputs | Forms a deadband around the process alarms which causes the corresponding process alarm status bit to remain set until the input moves beyond the trigger point by greater than the amount of the alarm deadband |
| Ch0ConfigCalBias | REAL | All inputs | A user configurable offset added directly into the data, Ch0Data. used to compensate for inherent sensor offset |
| Ch0ConfigConfig Bits | INT | All outputs | Collection of channel's individual configuration bits |

**Table B.6 Floating Point Configuration Tags**

| Tag Name | Data Type | Applicable Modules | Definition |
|---|---|---|---|
| Ch0ConfigHoldForInit | BOOL | All outputs | When set configures the channel to hold, or not change, until initialized with a value within 0.1% of full scale of its current value when one of the following conditions occurs:<br><br>1 = Module initial connection (power up)<br>2 = Module transition from Program mode back to Run mode<br>3 = Module reestablishes communications after fault |
| Ch0ConfigRamp AlarmLatch | BOOL | All outputs | Enables latching for the rate alarm. Latching causes the rate alarm to remain set until an unlatch service is explicitly sent to the channel or alarm |
| Ch0ConfigLimit AlarmLatch | BOOL | All outputs | Enables latching for the clamp limit alarms. Latching causes the limit alarms to remain set until an unlatch service is explicitly sent to the channel or alarm |
| Ch0ConfigFault Mode | BOOL | All outputs | Selects the behavior the output channel should take if a communications fault were to occur. Either hold last state (0) or go to a user defined value (1). Ch0ConfigFaultValue defines the value to go to on fault if the bit is set |
| Ch0ConfigProg Mode | BOOL | All outputs | Selects the behavior the output channel when transitioned into Program mode. Either hold last state (0) or go to a user defined value (1). Ch0ConfigProgValue defines the value to go to on program if the bit is set |
| Ch0ConfigRampTo Run | BOOL | All outputs | Enables ramping of the output value during Run mode between the current output level and a newly requested output. Ramping defines the maximum rate the output is allowed to transition at based upon the configured Ch0ConfigRampRate |
| Ch0ConfigRampToProg | BOOL | All outputs | Enables ramping of the output value to a user defined program value, Ch0ConfigProgValue, when set. Ramping defines the maximum rate the output is allowed to transition at based upon the configured Ch0ConfigRampRate |
| Ch0ConfigRampToFaul t | BOOL | All outputs | Enables ramping of the output value to a user defined fault value, Ch0FaultValue, when set. Ramping defines the maximum rate the output is allowed to transition at based upon the configured Ch0ConfigRampRate |
| Ch0ConfigMax RampRate | INT | All outputs | Configures the maximum rate at which the output value may change when transitioning to either the Ch0ConfigFaultValue or Ch0ConfigProgValue if either the Ch0ConfigRampToFault or Ch0ConfigRampToProg bits are set respectively, or in Run mode if Ch0ConfigRampToRun is set. In terms of percent full-scale per second |
| Ch0ConfigFault Value | REAL | All outputs | Defines the value, in engineering terms, the output should take on if a communications fault occurs when the Ch0ConfigFaultMode bit it set |
| Ch0ConfigProg Value | REAL | All outputs | Defines the value, in engineering units, the output should take on when the connection transitions to Program mode if the Ch0ConfigProgMode bit is set |
| Ch0ConfigLow Limit | REAL | All outputs | Defines the minimum value the output is allowed to take on within the process. If an output beneath the low limit is requested, the Ch0LLimit alarm is set and the output signal will remain at the configured low limit |
| Ch0ConfigHigh Limit | REAL | All outputs | Defines the maximum value the output is allowed to take on within the process. If an output above the high limit is requested, the Ch0HLimit alarm is set and the output signal will remain at the configured high limit |

## Notes:

# Using Ladder Logic To Perform Run Time Services and Reconfiguration

You can use ladder logic to perform run time services on your module. For example, page 10-10 shows how to unlatch alarms on the 1756-IF6I module using RSLogix 5000. This appendix provides an example of how to unlatch those same alarms **without using RSLogix 5000.**

In addition to performing run time services, you can use ladder logic to change configuration. Chapter 10 explained how to use the RSLogix 5000 software to set configuration parameters in your ControlLogix analog I/O module. Some of those parameters may also be changed through ladder logic.

## Using Message Instructions

In ladder logic, you can use message instructions to send occasional services to any ControlLogix I/O module. Message instructions send an explicit service to the module, causing specific behavior to occur, for example, unlatching a high alarm.

Message instructions maintain the following characteristics:

- messages use unscheduled portions of system communications bandwidth
- one service is performed per instruction
- performing module services does not impede module functionality, such as sampling inputs or applying new outputs

## Processing Real-Time Control and Module Services

Services sent via message instructions are not as time critical as the module behavior defined during configuration and maintained by a real-time connection. Therefore, the module processes messaging services only after the needs of the I/O connection have been met.

For example, you may want to unlatch all process alarms on the module, but real-time control of your process is still occurring using the input value from that same channel. Because the input value is critical to your application, the module prioritizes the sampling of inputs ahead of the unlatch service request.

This prioritization allows input channels to be sampled at the same frequency and the process alarms to be unlatched in the time between sampling and producing the real-time input data.

## One Service Performed Per Instruction

Message instructions will only cause a module service to be performed once per execution. For example, if a message instruction sends a service to the module to unlatch the high high alarm on a particular channel, that channel's high high alarm will unlatch, but may be set on a subsequent channel sample. The message instruction must then be reexecuted to unlatch the alarm a second time.

## Creating a New Tag

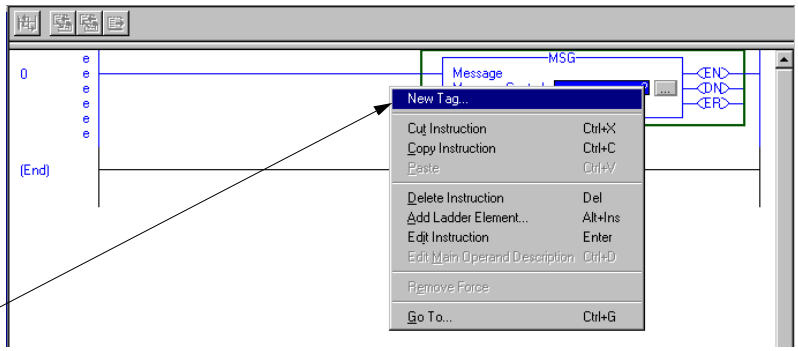
This ladder logic is written in the Main Routine.

Double-click here to enter the Main Routine

After adding a message instruction to a rung, you must create a tag for the message instruction

**A.** Right-click on the question mark (?) to see this pull-down menu.

**B.** Click on New Tag.




You must fill in the following information on the New Tag pop-up:

**IMPORTANT** We suggest you name the tag to indicate what module service is sent by the message instruction. For example, the message instruction below is used to unlatch a high alarm, and the tag is named to reflect this.

.

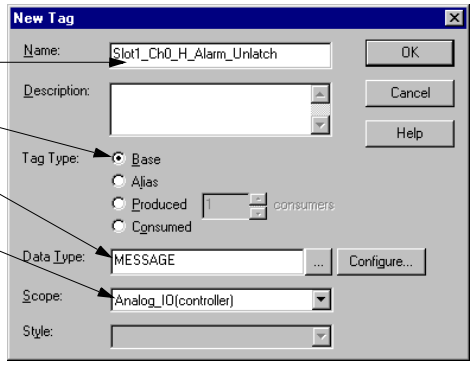
**A.** Name the tag.

**B.** Choose the Base tag type.

**C.** Choose the Message data type.

**D.** Choose the Controller scope.

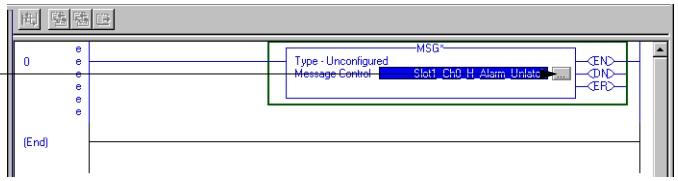
**IMPORTANT**: Message tags can only be created with the Controller Scope.



## Enter Message Configuration

After creating a new tag, you must enter message configuration.

Click here to see the message configuration pop-up screens




Enter message configuration on the following screens:

- Configuration pop-up screen
- Communications pop-up screen

A description of the purpose and set-up of each screen follows.

**IMPORTANT**

In RSLogix 5000, version 10 and greater, the message configuration screens changed significantly to make it easier for you to configure you messages.

For example, **in version 9 and earlier**, depending on the Message Type, you are required to configure some combination of the following:

- Service Code
- Object Type
- Object ID
- Object Attribute
- Source
- Number of Elements
- Destination

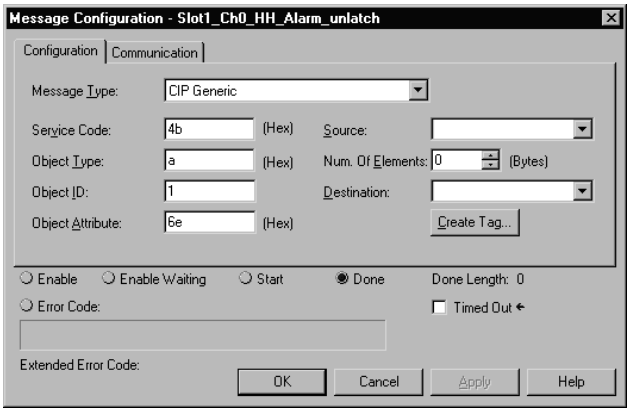
In **version 10 and greater**, however, you are only required to choose a Service Type. RSLogix 5000 fills in most of the fields listed above. You are only required to configure the Instance field; Instance represents the module channel on which the service is performed, if appropriate

The following sections show how to configure messages with RSLogix 5000, versions 9 and earlier and RSLogix 5000, versions 10 and greater.

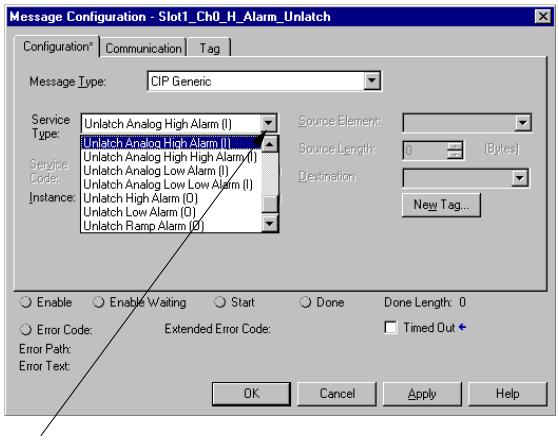
*Configuration Pop-Up Screen*

This pop-up screen provides information on what module service to perform and where to perform it. For example, you must use this screen to unlatch high high alarms (module service) on channel 0 of a 1756-IF6I module (where to perform service).

**RSLogix 5000, version 9 and earlier**




**RSLogix 5000, version 10 and greater**




In the newer versions of RSLogix 5000, you can use a pull-down menu to choose the Service Type. The list of available services includes multiple services to unlatch high high, high, low low, low, ramp and rate alarms.

Table C.1 contains required configuration pop-up screen information to perform input module services. This information is only necessary if you are configuring the message with **RSLogix 5000, versions 9 or earlier**:

**Table C.1 Analog Input Modules Configuration Pop-Up Screen Information**

| Enter the following: | To unlatch the high high alarm: | To unlatch the high alarm: | To unlatch the low alarm: | To unlatch the low low alarm: | To unlatch the rate alarm: |
|---|---|---|---|---|---|
| Service Code | 4B | 4B | 4B | 4B | 4B |
| Object Type | 0A | 0A | 0A | 0A | 0A |
| Object ID[1] (Channel Number) | 1-6 or 1-8 | 1-6 or 1-8 | 1-6 or 1-8 | 1-6 or 1-8 | 1-6 or 1-8 |
| Object Attribute | 6E | 6C | 6B | 6D | 6F |
| Number of Elements | 0 bytes | 0 bytes | 0 bytes | 0 bytes | 0 bytes |

(1) The 1756-IF16 module does not have any unlatchable features in the 16 channel mode.

**IMPORTANT**

For input or output modules, the Object Attribute determines which alarm feature for the selected channel to unlatch. If this field is left blank, **all alarms for the selected channel** will be unlatched.

You must send separate message instructions to control specific alarms on each channel of the module.

Also, Object ID represents channel number. For the 1756-IF6I, 1756-IR6I and 1756-IT6I modules, channels 0-5 are represented by Object ID 1-6. For the 1756-IF16 (in differential mode only) and 1756-IF8 modules, channels 0-7 are represented by Object ID 1-8.

Table C.2 contains required configuration pop-up screen information to perform output module services. This information is only necessary if you are configuring the message with **RSLogix 5000, versions 9 or earlier**:

**Table C.2 Analog Output Modules Configuration Pop-Up Screen Information**

| Enter the following: | To unlatch the high alarm: | To unlatch the low alarm: | To unlatch the ramp alarm: |
|---|---|---|---|
| Service Code | 4B | 4B | 4B |
| Object Type | 0B | 0B | 0B |
| Object ID<br><br>(Channel Number) | 1-6 or 1-8 | 1-6 or 1-8 | 1-6 or 1-8 |
| Object Attribute | 6F | 6E | 70 |
| Number of Elements | 0 bytes | 0 bytes | 0 bytes |

*Communications Pop-Up Screen*

This pop-up screen provides information on the path of the message instruction. For example, the slot number of a 1756-IF6I distinguishes exactly which module a message is designated for.

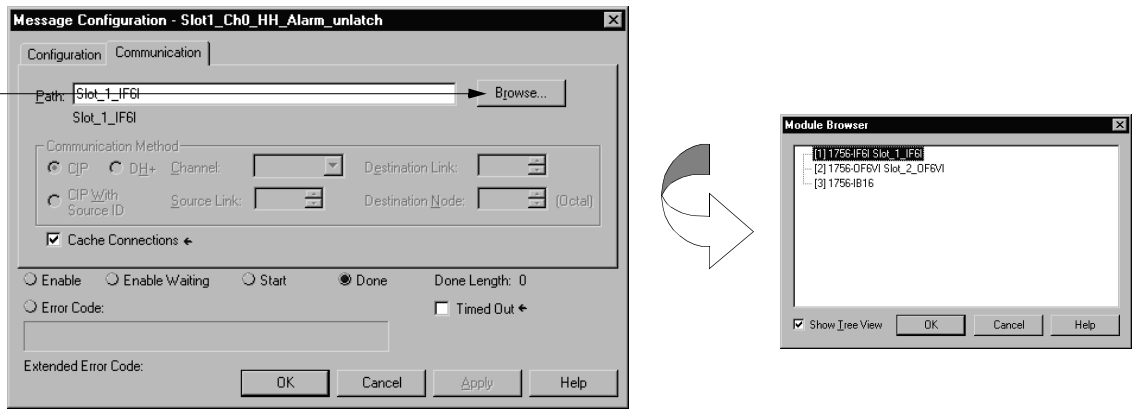
**IMPORTANT**

Use the Browse button to see a list of the I/O modules in the system. You choose a path when you choose a module from the list.

You must name an I/O module during initial module configuration to choose a path for your message instruction.

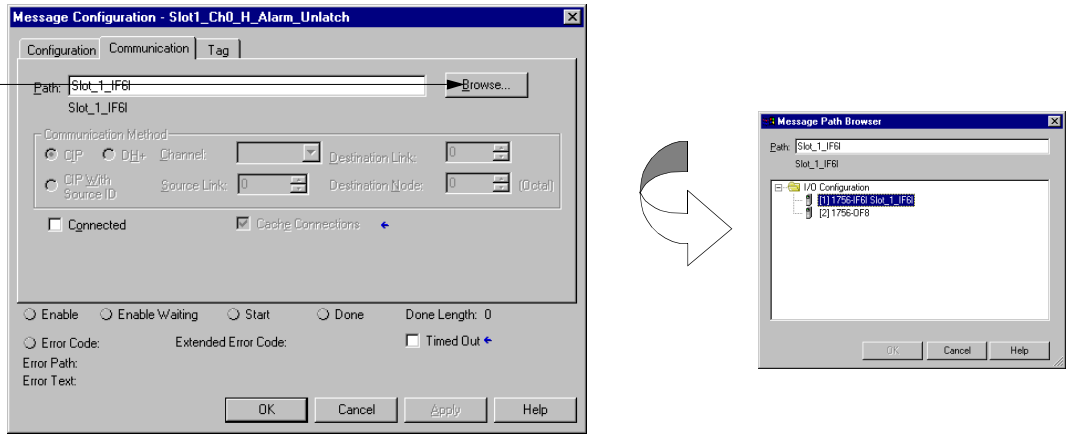
**RSLogix 5000, version 9 and earlier**

Use this Browse button to see a list.




**RSLogix 5000, version 10 and greater**

Use this Browse button to see a list.



## Unlatch Alarms in the 1756-IF6I

Example Rungs 0-4 show how to unlatch the following alarms in a 1756-IF6I module, named *Slot_1_IF6I*:

- Channel 0 High high alarm - Rung 0
- Channel 0 High alarm - Rung 1
- Channel 0 Low alarm - Rung 2
- Channel 0 Low low alarm - Rung 3
- Channel 0 Rate alarm - Rung 4

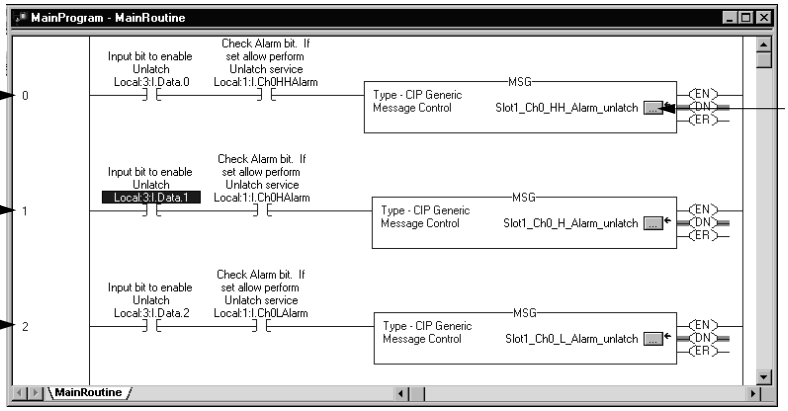
**IMPORTANT** An I/O module must be configured to latch alarms, see pages 10-9 & 10-13, before you can perform unlatch services using ladder logic. If an unlatch service is received by a module not configured to latch alarms, the message instruction will error.

Also, all alarms for channel 0 can be unlatched simultaneously with a single message instruction by leaving the object attribute field blank.

**Rung 0** unlatches the high high alarm.

**Rung 1** unlatches the high alarm.

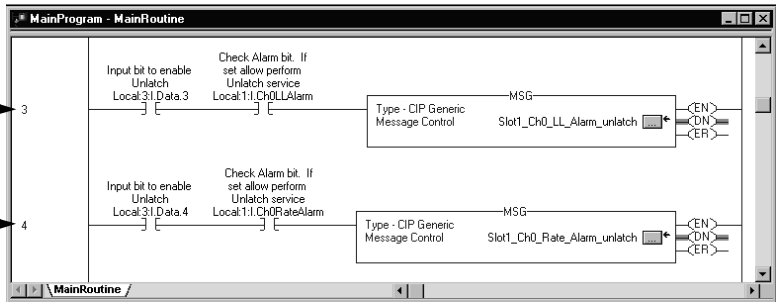
**Rung 2** unlatches the low alarm.




Click on the box in each rung to see the configuration and communication information pop-up associated with it. This information is explained on the next page.

**Rung 3** unlatches the low low alarm.

**Rung 4** unlatches the rate alarm.



## *Configuration Pop-Up Screens*

The screen below shows the Configuration pop-up for Rung 0.

**RSLogix 5000, version 9 and earlier**

This pop-up screen contains the same information for each rung, except for the Object Attribute field. The information in this field is as follows:

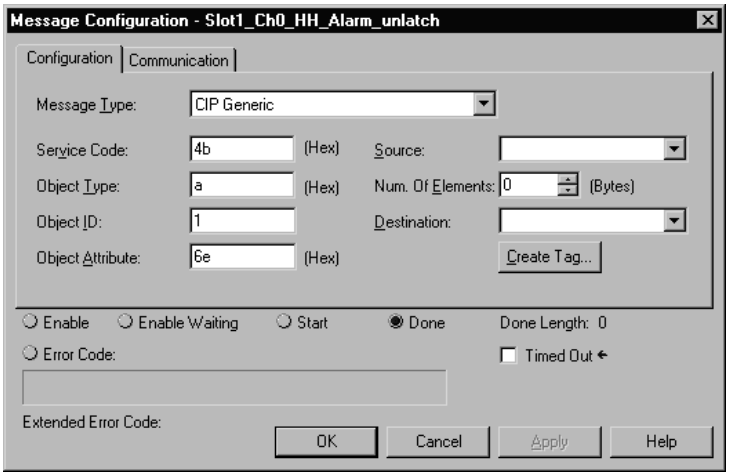
Rung 0 - 6e

Rung 1 - 6c

Rung 2 - 6b

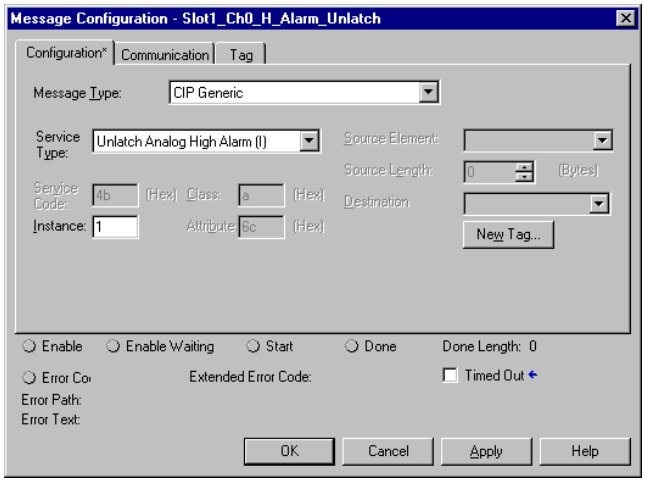
Rung 3 - 6d

Rung 4 - 6f




**RSLogix 5000, version 10 and greater**

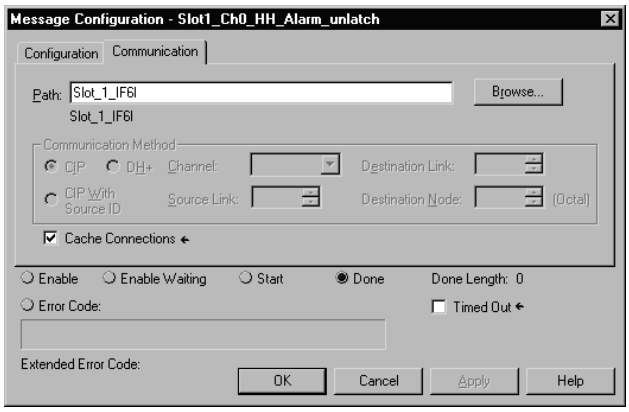
With the newer RSLogix 5000 versions, you are only required to choose a service type and configure the instance.



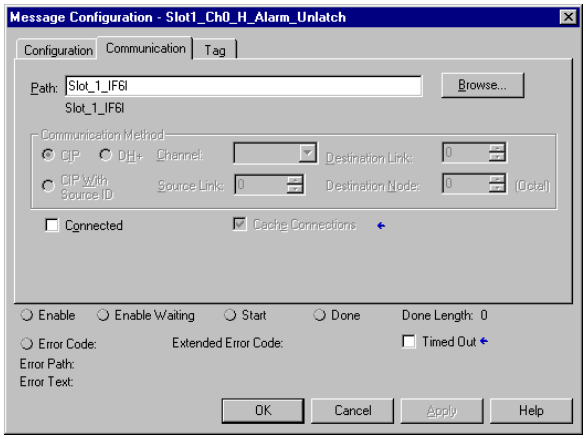
## *Communications Pop-Up Screens*

The screen below shows the Communications pop-up for Rung 0. This pop-up screen is the same for each rung of this example.

**RSLogix 5000, version 9 and earlier**




**RSLogix 5000, version 10 and greater**




**IMPORTANT** You must name an I/O module to set the message path under that module's communication tab.

## Unlatch Alarms in the 1756-OF6VI

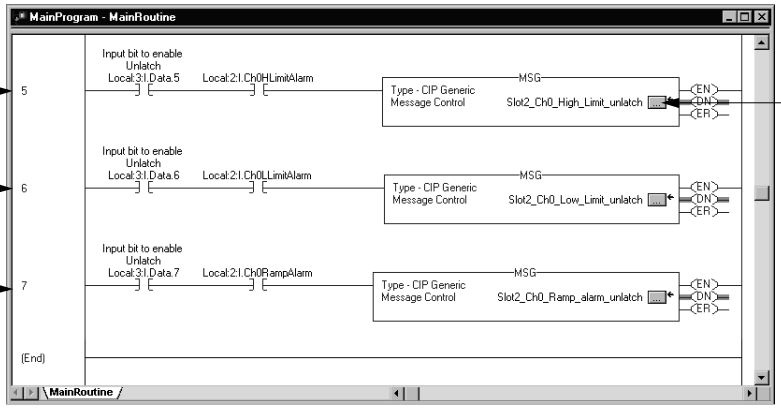
Example Rungs 5-7 show how to unlatch the following alarms in a 1756-OF6VI module:

- High limit alarm - Rung 5
- Low limit alarm - Rung 6
- Ramp alarm - Rung 7

**Rung 5** unlatches the high limit alarm.

**Rung 6** unlatches the low limit alarm.

**Rung 7** unlatches the ramp alarm.

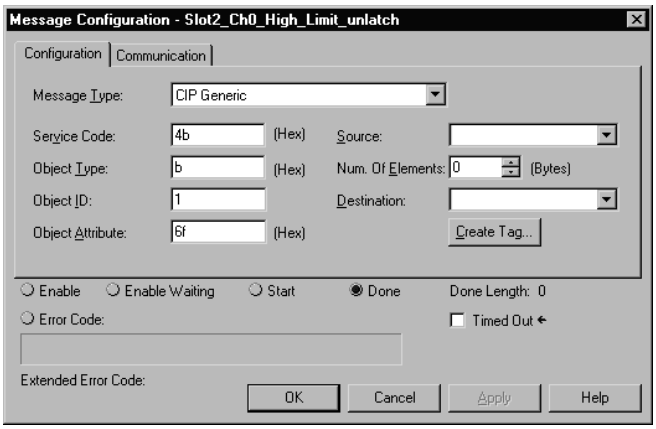



Click on the box in each rung to see the configuration and communication information pop-up associated with it. This information is explained below.

### *Configuration Pop-Up Screens*

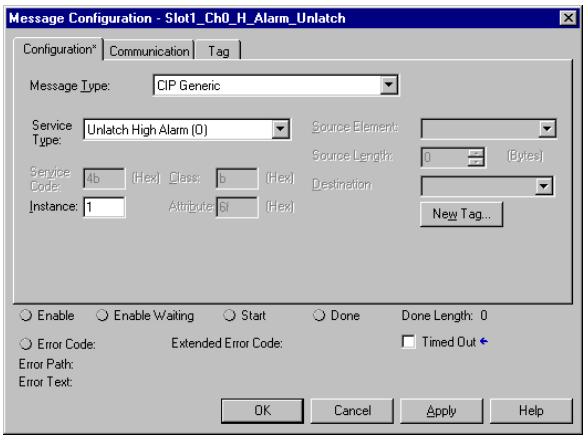
The screen below shows the Configuration pop-up for Rung 5.

**RSLogix 5000, version 9 and earlier**




This pop-up screen contains the same information for each rung, except for the Object Attribute field. The information in this field is as follows:
Rung 5 - 6f
Rung 6 - 6e
Rung 7 - 70

**RSLogix 5000, version 10 and greater**

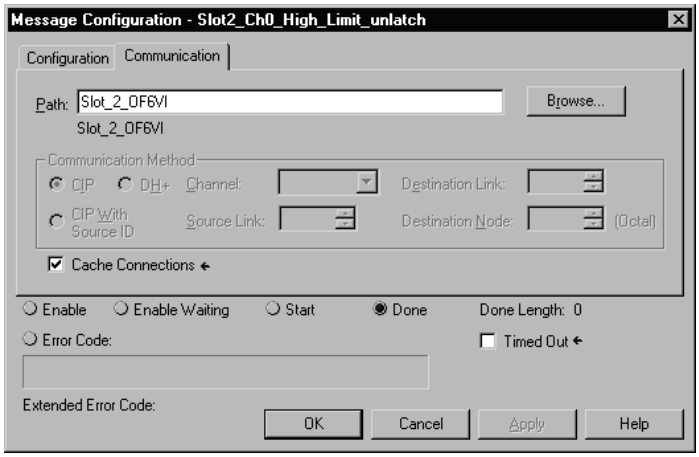



With the newer RSLogix 5000 versions, you are only required to choose a service type and configure the instance.

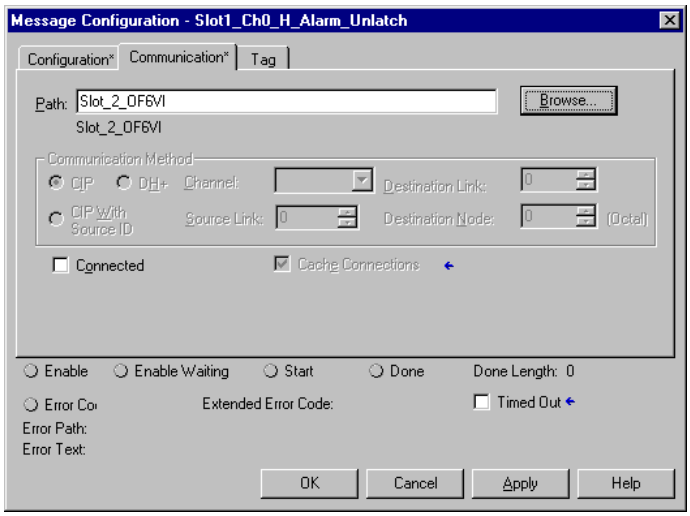
### *Communications Pop-Up Screens*

The screen below shows the Communications pop-up for Rung 5. This pop-up is the same for each rung in this example.

**RSLogix 5000, version 9 and earlier**




**RSLogix 5000, version 10 and greater**




**IMPORTANT** You must name an I/O module to set the message path under that module's communication tab.

## Reconfiguring a 1756-IR6I Module

It is sometimes advantageous to change the functional operation of a module in the ControlLogix system automatically via the user program rather than using RSLogix5000 software to reconfigure it. This way, changes in the process can dictate when the reconfiguration should take place rather than the user performing that function manually.

The following steps are used in this example when reconfiguring a module via ladder are:

1. Move new configuration parameters to the Configuration portion of the Tag Structure associated with the module.

2. If you are using RSLogix 5000, **version 10 or greater**, use a message instruction to send a Reconfigure Module service to the same module.

   If you are using RSLogix 5000, **version 9 or earlier**, use a message instruction to send a Reset Module service to the same module to trigger sending the configuration data.

Before the new configuration parameters are sent to the module, the user must make sure that their relationship to each other is in a format the module will accept (see tables below).

**IMPORTANT** Reconfiguring analog modules via ladder should be limited to functions that involve **the changing of values only**. We do not recommend that enabling or disabling features be done via ladder. Use RSLogix 5000 to enable or disable these features.

Table C.3 and Table C.4 list module parameters that may be changed via ladder logic:

**Table C.3 Permissible Analog Input Module Parameters to Change Via Ladder Logic**

| Feature: | Restriction: |
|---|---|
| High Engineering Value | Must not be equal to low engineering value |
| Low Engineering Value | Must not be equal to high engineering value |
| High-High Alarm Value | Must be greater than or equal to high alarm value |
| High Alarm Value | Must be greater than low alarm value |
| Low Alarm Value | Must be less than high alarm value |
| Low-Low Alarm Value | Must be less than or equal to low alarm value |
| Deadband | Must be less than half of high alarm minus low alarm |

**Table C.4 Permissible Analog Output Module Parameters to Change Via Ladder Logic**

| Feature: | Restriction: |
|---|---|
| High Clamp Value(1) | Must be greater than low clamp value |
| Low Clamp Value(1) | Must be less than high clamp value |

(1) The values for user-defined state at Fault or Program (set during initial configuration) must fall within the range of the High and Low Clamp values.

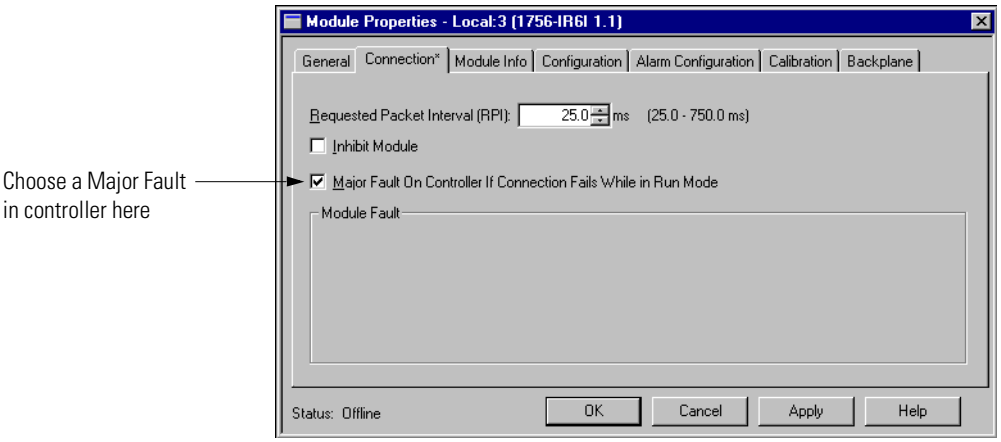
## Considerations With This Ladder Logic Example

**IMPORTANT** The considerations listed in this section only apply if you are using RSLogix 5000, version 9 or earlier.

If you are using RSLogix 5000, **version 10 or greater, none of these considerations apply.**

Remember the following when using this method of module reconfiguration using the reset service:

- When this method of reconfiguration is used on Output modules, ALL module outputs will be reset to Zero for at least three seconds
- This method of reconfiguration will cause a Major Fault in the controller if the module was initially configured to do so on the following screen:



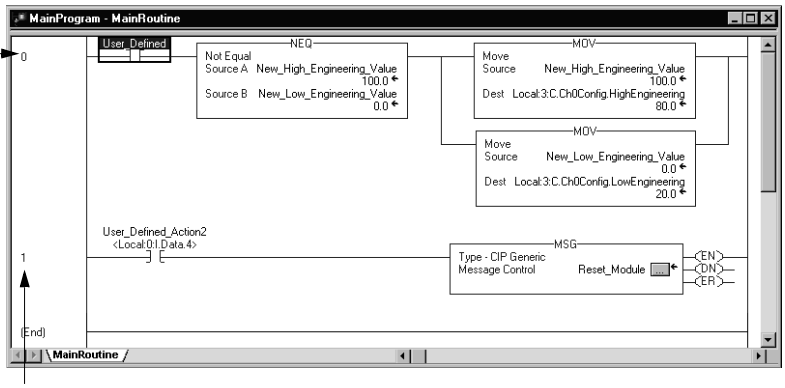

- All Listen-Only controllers will lose their connections to the module for a minimum of three seconds after the Reset is performed.
- If the Reconfiguration is performed on an Input module with multiple owners, then all owners will lose their connections simultaneously after the Reset is performed. In order to re-establish all their connections, all owners must change their configuration to the same values BEFORE the Reset is performed.

The following ladder example shows how to change the High and Low Engineering Values (Scaling Parameters) for an Analog Output module in Slot 3 of the Local Chassis:

**Rung 0**

This rung moves new Channel 0 scaling parameters to the configuration portion of the structure associated with an analog output module in Slot 3 of the local chassis.

The new values move at the user's discretion (represented by the user defined XIC instruction) after making sure the desired new high value is not equal to the desired new low value. This rung only moves the data to the configuration portion of the structure but does not send it to the module.




**Rung 1**

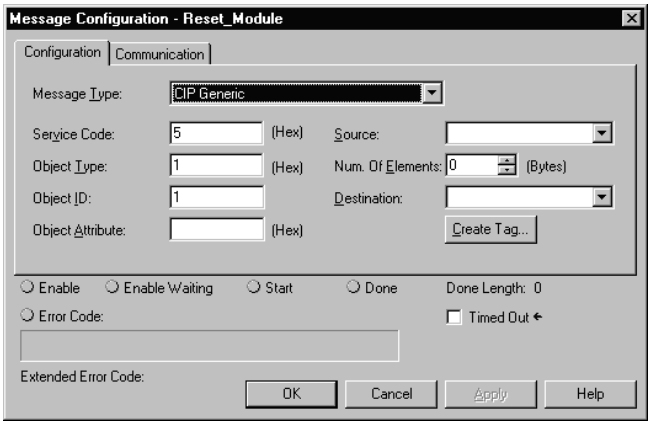
This rung sends the Reset Module service to the analog output module. Upon receipt, the module will initiate a hardware reset on itself, behaving as though it has just been inserted into the system. A connection is established and the new configuration parameters are sent.

### *Perform Module Reset Service*

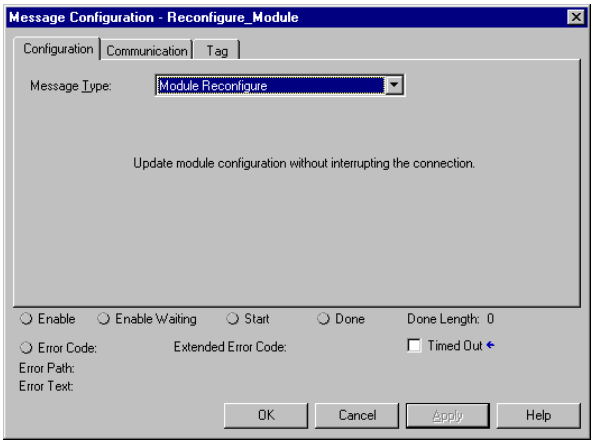
The following configuration and communication pop-up screens show the **message instruction to perform the Reset service** and its path:

The screen below shows the Configuration pop-up.

**RSLogix 5000, version 9 and earlier**

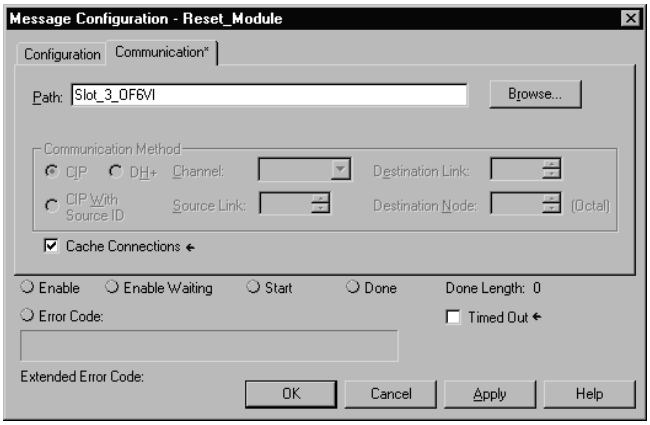



**RSLogix 5000, version 10 and greater**

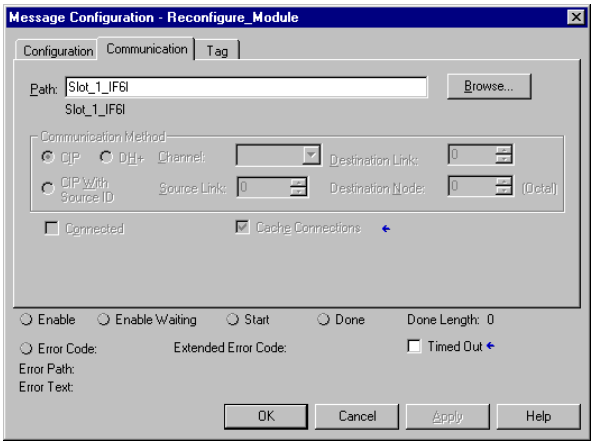


The screen below shows the Configuration pop-up.

**RSLogix 5000, version 9 and earlier**




**RSLogix 5000, version 10 and greater**



## Notes:

# Power Supply Sizing Chart

Use Table D.1 to check the power your ControlLogix chassis is using.

**Table D.1**

| Slot number | Module Catalog Number | Current @ 5.1 VDC (mA) | | Power @ 5.1 VDC (Watts) | Current @ 24 VDC (mA) | | Power @ 24 VDC (Watts) | Current @ 3.3 VDC (mA) | | Power @ 3.3 VDC (Watts) |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | | | x 5.1V = | | | x 24V = | | | x 3.3V = | |
| 1 | | | x 5.1V = | | | x 24V = | | | x 3.3V = | |
| 2 | | | x 5.1V = | | | x 24V = | | | x 3.3V = | |
| 3 | | | x 5.1V = | | | x 24V = | | | x 3.3V = | |
| 4 | | | x 5.1V = | | | x 24V = | | | x 3.3V = | |
| 5 | | | x 5.1V = | | | x 24V = | | | x 3.3V = | |
| 6 | | | x 5.1V = | | | x 24V = | | | x 3.3V = | |
| 7 | | | x 5.1V = | | | x 24V = | | | x 3.3V = | |
| 8 | | | x 5.1V = | | | x 24V = | | | x 3.3V = | |
| 9 | | | x 5.1V = | | | x 24V = | | | x 3.3V = | |
| 10 | | | x 5.1V = | | | x 24V = | | | x 3.3V = | |
| 11 | | | x 5.1V = | | | x 24V = | | | x 3.3V = | |
| 12 | | | x 5.1V = | | | x 24V = | | | x 3.3V = | |
| 13 | | | x 5.1V = | | | x 24V = | | | x 3.3V = | |
| 14 | | | x 5.1V = | | | x 24V = | | | x 3.3V = | |
| 15 | | | x 5.1V = | | | x 24V = | | | x 3.3V = | |
| 16 | | | x 5.1V = | | | x 24V = | | | x 3.3V = | |
| | **TOTALS** | **mA** | | **W** | **mA** | | **W** | **mA** | | **W** |
| | | This number cannot exceed 10000mA | | | This number cannot exceed 2800mA | | | This number cannot exceed 4000mA | | |
| | | | | **These three numbers added together cannot exceed:**<br>**70W @40°C**<br>**55W @ 60°C** | | | | | | |

**IMPORTANT** We recommend that you copy this worksheet for use in checking the power supply of each ControlLogix chassis used.

## Notes:

# Additional Specification Information

This appendix offers additional calibration information that may assist you in using the ControlLogix analog I/O module.


| For more information on: | See page: |
|---|---|
| Analog to Digital (A/D) Converter Accuracy | E-1 |
| Calibrated Accuracy | E-2 |
| Error Calculated Over Hardware Range | E-3 |
| How Operating Temperature Changes Affect Module Accuracy | E-3 |
| RTD Error | E-5 |
| Thermocouple Error | E-6 |
| Thermocouple Resolution | E-14 |


## Analog to Digital (A/D) Converter Accuracy

There are two types of calibration that occur on a ControlLogix analog I/O module.

- The user-directed and user-performed calibration process described in Chapter 11. This type of calibration occurs only when you determine it is necessary and involves an external calibration instrument like those listed in Table 11.1 on page 11-2.

- A self-calibration process that takes place internally on ControlLogix analog I/O modules when either of the following events occurs:
  - Module power is cycled
  - You begin the user calibration described in Chapter 11.

  The "A/D self-calibration" feature maintains the accuracy of the A/D convertor found on all 1756 isolated analog modules. This feature executes each time the module cycles power or when a self-calibration cycle is initiated.

  The self-calibration compensates for inaccuracies of the on-board reference signal and the A/D convertor only. In other words, the self-calibration feature makes sure that the A/D convertor itself is accurate with respect to its on-board voltage reference that is used for a conversion of the input signal. Together with user calibration, the module's total accuracy is maintained.

## Calibrated Accuracy

The *Calibrated Accuracy* specification represents the module's accuracy when its ambient (i.e. operating) temperature is the same as the temperature at which the module was calibrated.

Immediately following a calibration, a ControlLogix analog I/O module is most accurate. Because the module was calibrated at its zero and span, the inaccuracy is largely non-linearity between zero and span. Assuming the module is operating at the exact temperature when it was calibrated and uses the same voltage source to check the post-calibration accuracy, a module may be as accurate as 0.01% to 0.05% of range.

Once the module begins operation, its accuracy lessens as components change over time. However, this change (in components or accuracy) is different from the Gain Drift With Temperature specification described on page E-3.

Other than non-linearity, the *Calibrated Accuracy @ 25°C* specification represents a time drift/aging specification between calibrations. A module with a calibration accuracy of 0.01% of range immediately following calibration is estimated to be better than 0.1% of range @ 25°C for one year (i.e. the calibration cycle).

The reason for the difference between 0.01% and 0.1% of range is that the *Calibrated Accuracy @ 25°C* specification must capture the effect of component aging until the next time the module is calibrated. Primarily, the module's operating conditions, such as temperature, humidity, and power cycling, affect component aging.

Because ControlLogix analog I/O modules operate in different conditions, the specific accuracy deviation from 0.01% of range cannot be measured. Typically, however, a module's *Calibrated Accuracy @ 25°C* is closer to 0.05% of range than 0.1% of range as the 0.1% of range is determined by the worst case scenario operating conditions.

## Error Calculated Over Hardware Range

A ControlLogix analog I/O module's calibration accuracy at 25°C is calculated over the full hardware range of the module and is not dependent on the application's use of the range. The error is the same if you are measuring it across a 10% or 100% portion of a given range.

However, a module's accuracy at 25°C is dependent on the hardware range in which the module operates.

**EXAMPLE**

The 1756-IT6I module offers two input ranges, -12 to 30mV and -12 to 78mV. Because module error at 25°C depends on the input range used, the module error is as follows when using 0.1% of range accuracy:

- +/- 42µV for the -12 to 30mV range
- +/- 90µV for the -12 to 78mV range

These error values are the same whether you use 10% or 100% of the chosen range.

## How Operating Temperature Changes Affect Module Accuracy

The following specifications take into account how the module's operating temperature changes can affect a module's accuracy:

- Gain Drift With Temperature
- Module Error Over Full Temperature Range

### Gain Drift With Temperature

The *Gain Drift with Temperature* specification represents the calibration inaccuracy that occurs as a module's ambient (i.e. operating) temperature drifts from the temperature at which it was calibrated.

You can use the *Gain Drift with Temperature* specification (varies for each catalog number) to determine the module's calibration inaccuracy for each degree between calibration and operating temperature. The *Gain Drift with Temperature* specification represents a percentage of the full operating range that the module's calibration is inaccurate to for each degree difference. The specification is determined with the following formula:

Gain Drift with Temperature = (PPM/°C) x Module's Full Range

Because the specifications listed in Appendix A include a typical and worst case PPM/°C for each module, you can determine multiple Gain Drift with Temperature values for each module.

**EXAMPLE**

For example, the 1756-IT6I module has a maximum *Gain Drift with Temperature* specification of 80ppm/°C. The 80ppm represents 0.008% of the module's full operating temperature.

If the module was calibrated to operate in the -12mV to 78mV input range, then following formula is used:

(0.008/°C) x 90mV = +/-7.2µV/°C

For every degree C that the module's operating temperature moves from the calibration temperature, the maximum calibration accuracy deviation is +/-7.2µV.

## Module Error Over Full Temperature Range

The *Module Error Over Full Temperature Range* specification represents the error that occurs if the module's ambient temperature changes a total of 60°C (i.e. from 0 to 60°C or 60 to 0°C). While this temperature change is extremely unlikely, it represents the worst case scenario.

This specification is determined by multiplying the temperature change by the maximum *Gain Drift with Temperature* for the given module. In other words, we determine Module Error Over Full Temperature Range with the following formula:

Module Error Over Full Temperature = Full Temperature Range x Gain Drift with Temperature

**EXAMPLE**

The 1756-IT6I module has a maximum *Gain Drift with Temperature* specification = 80 ppm/°C.

*Module Error over Full Temperature Range* = 60°C (full temperature range) X 80 ppm/°C (gain drift). The result is 4800 ppm or 0.48%.

## RTD and Thermocouple Error Calculations

When you using the temperature-measuring modules (1756-IR6I, 1756-IT6I and 1756-IT6I2), error calculations are achieved in the following two-step process:

1. Calculate the module's error in ohms or volts
2. Convert the ohm/volt error to temperature for the specific sensor and at the correct application temperature

### RTD Error

Module error on the 1756-IR6I module is defined in ohms and is calculated across the entire input range selected, not the available range of a sensor used with the module. For example, if the 1 ohm to 487 ohm input range is used, the module error is calculated across 507 ohms (actual range = 0.86 ohms to 507.86 ohms).

The error in ohms translates to temperature, but that translation varies because the relationship is non-linear. The most effective way to check 1756-IR6I module error is to calculate the error in ohms and use that value in a linearization table to check the temperature error.

If the module is calibrated at operating temperature and the operating temperature remains relatively stable, calibration accuracy is better than 0.1% of the full range for the first year after calibration. This 0.1% value is a worst case value. In other words, with the 1 ohm to 487 ohms input range selected, the worst case module error is 0.507 ohms.

Finally, you must check an RTD linearization table to determine the temperature error to which an error of 0.507 ohms translates. For example, if the 1756-IR6I has a 0.1% (or 0.507 ohms) error and is operating at 0°C, the temperature error is -1.25°C to +1.2°C–when the Platinum 385 sensor type is used. However, this same ohms error calculated in an operating temperature of 200°C translates to a temperature error of -1.4°C to +1.4°C.

## Thermocouple Error

Thermocouple error at 25°C indicates the module's accuracy in measuring temperature. This accuracy varies depending on the following factors:

- Input range used, either:
  - -12 to 30mV
  - -12 to 78mV
- Thermocouple type, any of the following:
  - B, R, S, E, J, K, N, T, L or D (L and D types can be used with the 1756-IT6I2 only)
- Application temperature (i.e. the temperature of the physical location where the thermocouple is being used)

**EXAMPLE**

For example, when the 1756-IT6I module is operating in the following conditions:

- -12 to 30mV input range
- connected to a type S thermocouple
- application temperature of 1200°C

the module error at 25°C is +/-1.75 degrees.

In other words, the difference between the temperature the module reports and the actual application temperature can be +/- 1.75 degrees.

The module may report an application temperature of 1200° celsius in this case when the actual temperature can be in the range from 1196.26 to 1203.74° celsius.

**IMPORTANT**

When determining the thermocouple error, we used a typical error of 0.05% of temperature range. The error calculations are listed for each range (i.e. -12 to 30mv and -12 to 78mV) in the rest of this section.

However, keep in mind that if cold junction compensation is performed on the thermocouple modules, the cold junction sensor error values must be added to the +/-1.75 degrees value in the example above and the numbers listed in the rest of this section.

## Module Error at 25°C (-12 to 30mV Range)

Table E.1 lists the ControlLogix thermocouple modules' error at 25°C when used in the -12 to 30mV input range.

**Table E.1**

| Application Temperature | Module Error (in degrees) at 25°C When Connected to This Thermocouple Type: | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | B | R | S | E[1] | J[2] | K[3] | N[4] | T |
| -200°C | | | | 0.836 | 0.96 | 1.376 | 2.115 | 1.334 |
| 0°C | | | | 0.358 | 0.42 | 0.532 | 0.803 | 0.542 |
| 200°C | | 2.37 | 2.48 | 0.284 | 0.38 | 0.525 | 0.637 | 0.395 |
| 400°C | | 2.02 | 2.19 | 0.262 | 0.38 | 0.497 | 0.566 | 0.340 |
| 600°C | 3.53 | 1.85 | 2.06 | | | 0.494 | 0.539 | |
| 800°C | 2.75 | 1.71 | 1.93 | | | | 0.535 | |
| 1000°C | 2.30 | 1.59 | 1.82 | | | | | |
| 1200°C | 2.03 | 1.51 | 1.75 | | | | | |
| 1400°C | 1.86 | 1.49 | 1.73 | | | | | |
| 1600°C | 1.80 | 1.51 | 1.77 | | | | | |
| 1800°C | 1.83 | 1.71 | 2.04 | | | | | |

(1) Type E thermocouples can only be used in applications up to 400°C.

(2) Type J thermocouples can only be used in applications up to 550°C.

(3) Type K thermocouples can only be used in applications up to 700°C.

(4) Type N thermocouples can only be used in applications up to 800°C.

The information represented in Table E.1 is shown graphically in Figure E.1 through Figure E.8.

**Figure E.1 Thermocouple Module Error at 25° - Type B Thermocouple Connection in a -12 to 30mV Input Range**

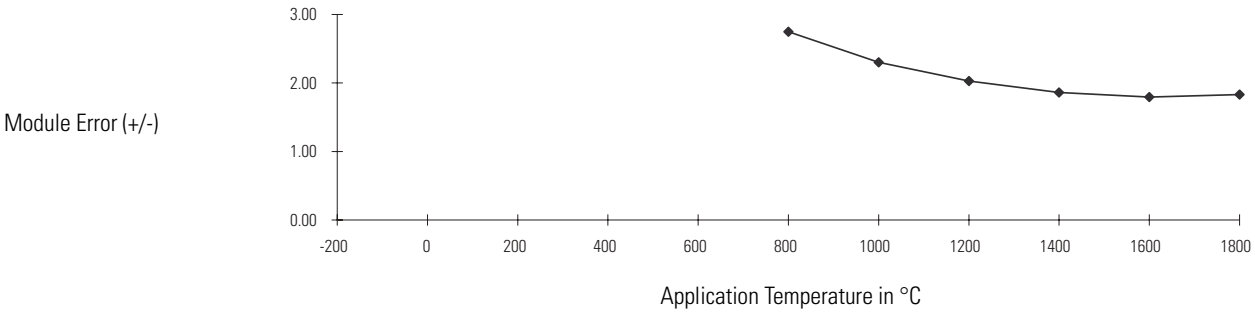


**Figure E.2 Thermocouple Module Error at 25° - Type R Thermocouple Connection in a -12 to 30mV Input Range**

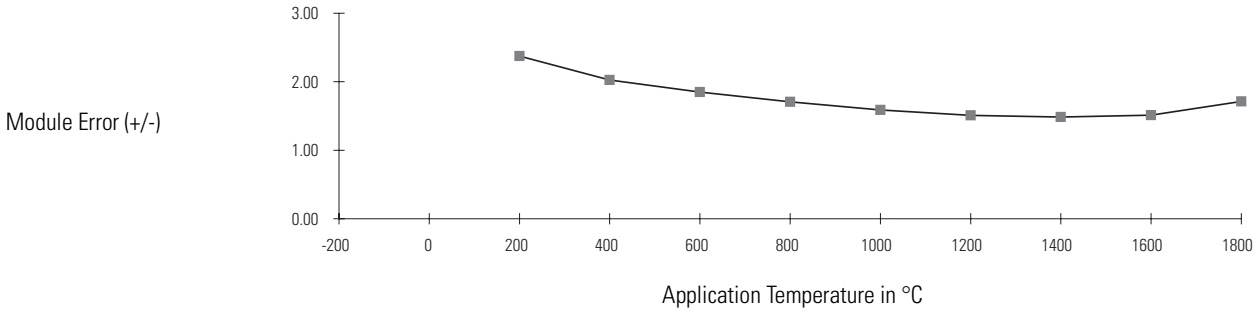



**Figure E.3 Thermocouple Module Error at 25° - Type S Thermocouple Connection in a -12 to 30mV Input Range**

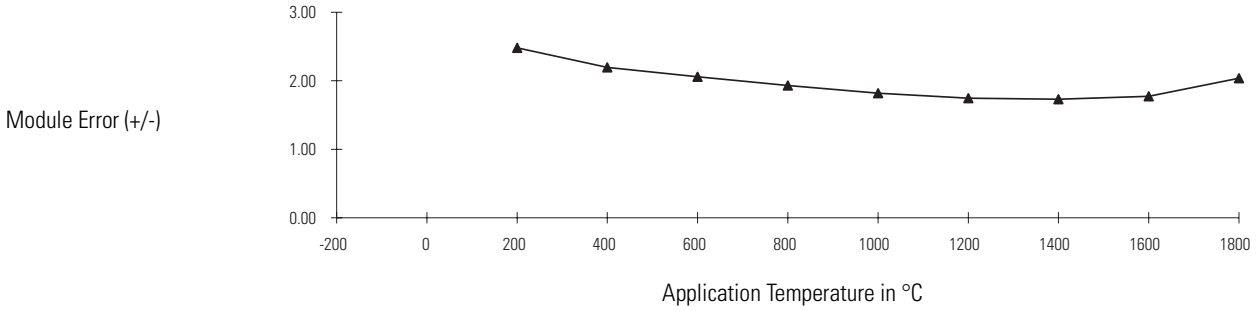



**Figure E.4 Thermocouple Module Error at 25° - Type E Thermocouple Connection in a -12 to 30mV Input Range**

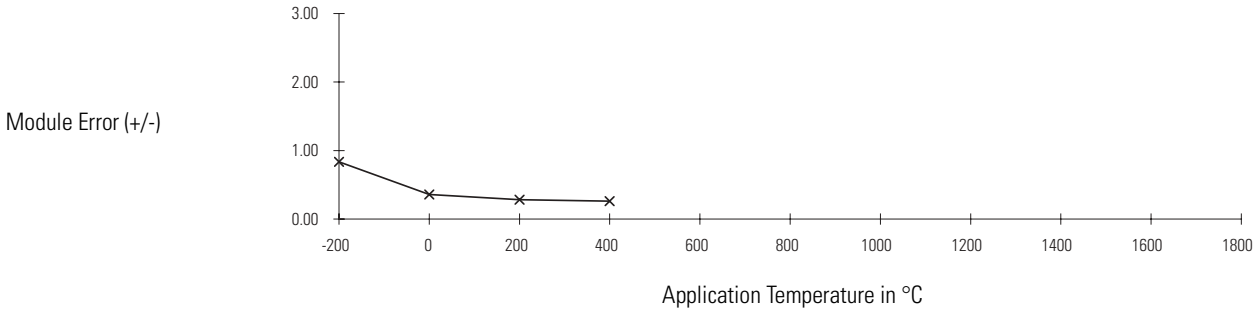


**Figure E.5 Thermocouple Module Error at 25° - Type J Thermocouple Connection in a -12 to 30mV Input Range**

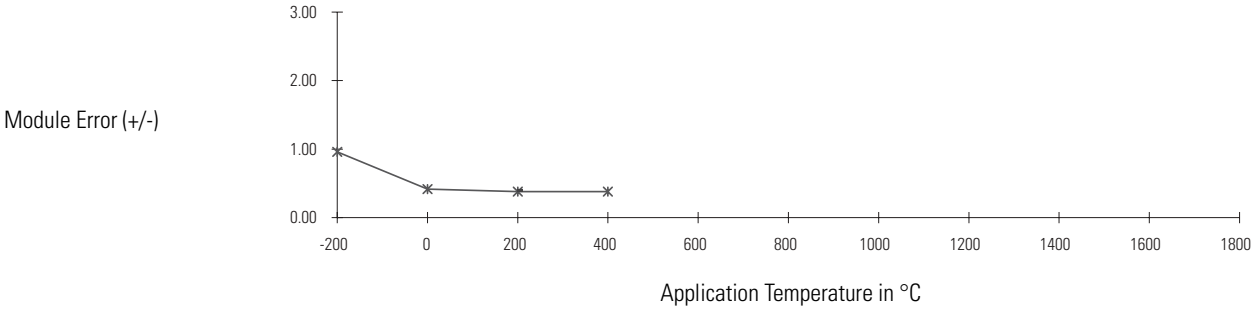



**Figure E.6 Thermocouple Module Error at 25° - Type K Thermocouple Connection in a -12 to 30mV Input Range**

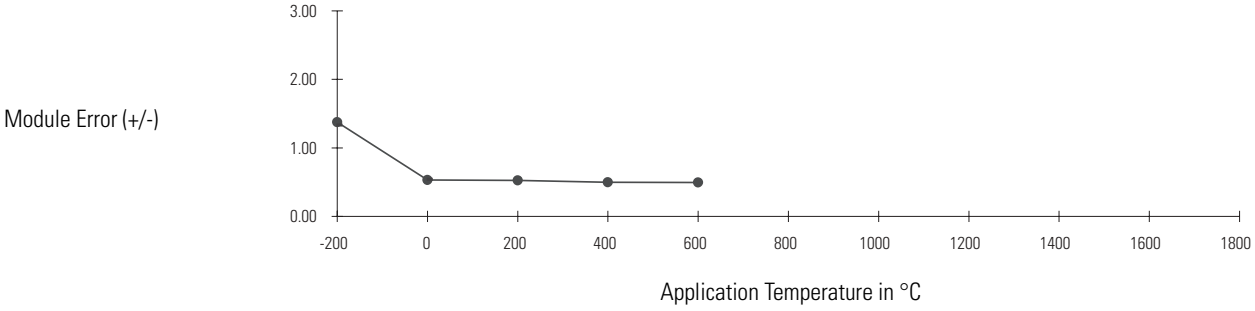



**Figure E.7 Thermocouple Module Error at 25° - Type N Thermocouple Connection in a -12 to 30mV Input Range**

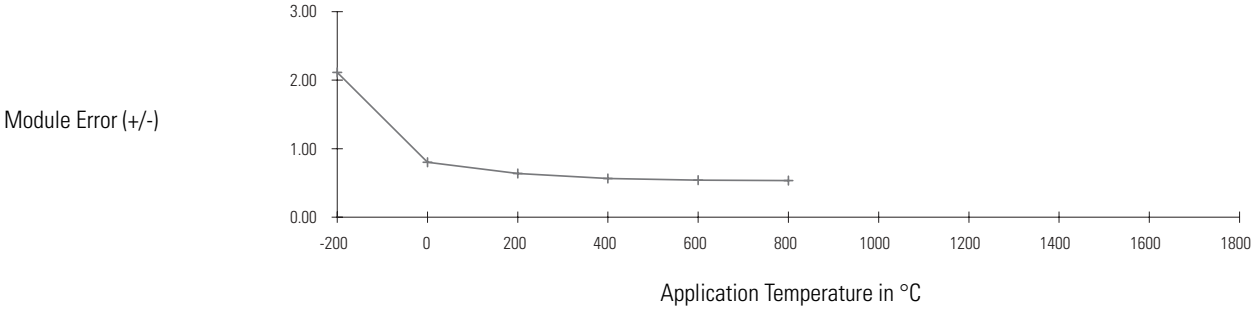
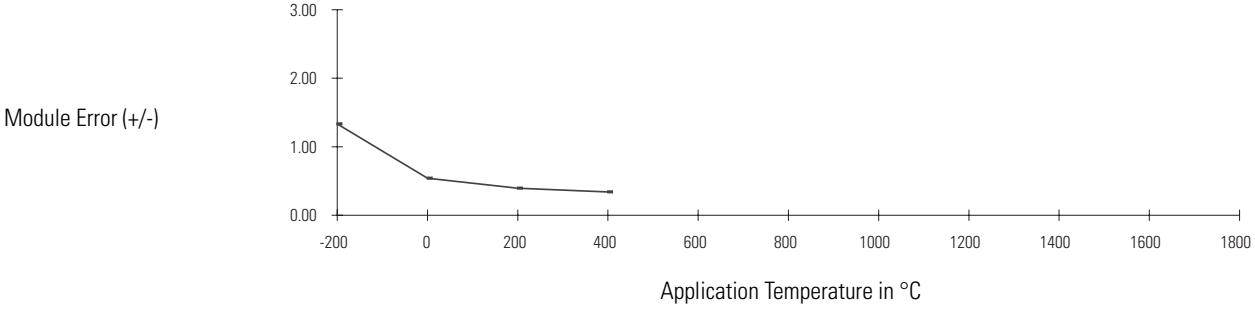



**Figure E.8 Thermocouple Module Error at 25° - Type T Thermocouple Connection in a -12 to 30mV Input Range**



## Module Error at 25°C (-12 to 78mV Range)

Table E.2 lists the ControlLogix thermocouple modules' error at 25°C when used in the -12 to 78mV input range.

**Table E.2**

| Application Temperature in °C: | Module Error (in degrees) at 25°C When Connected to This Thermocouple Type: | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | **B** | **R** | **S** | **E** | **J** | **K** | **N** | **T** |
| -200°C | | | | 1.791 | 2.06 | 2.949 | 4.532 | 2.859 |
| 0°C | | | | 0.767 | 0.89 | 1.141 | 1.720 | 1.161 |
| 200°C | | 5.09 | 5.32 | 0.608 | 0.81 | 1.126 | 1.364 | 0.847 |
| 400°C | | 4.34 | 4.70 | 0.562 | 0.82 | 1.065 | 1.212 | 0.728 |
| 600°C | 7.56 | 3.96 | 4.41 | 0.558 | 0.77 | 1.059 | 1.155 | |
| 800°C | 5.89 | 3.65 | 4.14 | 0.574 | 0.70 | 1.098 | 1.146 | |
| 1000°C | 4.93 | 3.40 | 3.90 | 0.599 | 0.76 | 1.154 | 1.165 | |
| 1200°C | 4.35 | 3.23 | 3.74 | | 0.79 | 1.233 | 1.210 | |
| 1400°C | 3.99 | 3.18 | 3.71 | | | 1.328 | | |
| 1600°C | 3.85 | 3.24 | 3.80 | | | | | |
| 1800°C | 3.92 | 3.67 | 4.36 | | | | | |

The information represented in Table E.2 is shown graphically in Figure E.9 through Figure E.16.

**Figure E.9 Thermocouple Module Error at 25° - Type B Thermocouple Connection in a -12 to 78mV Input Range**

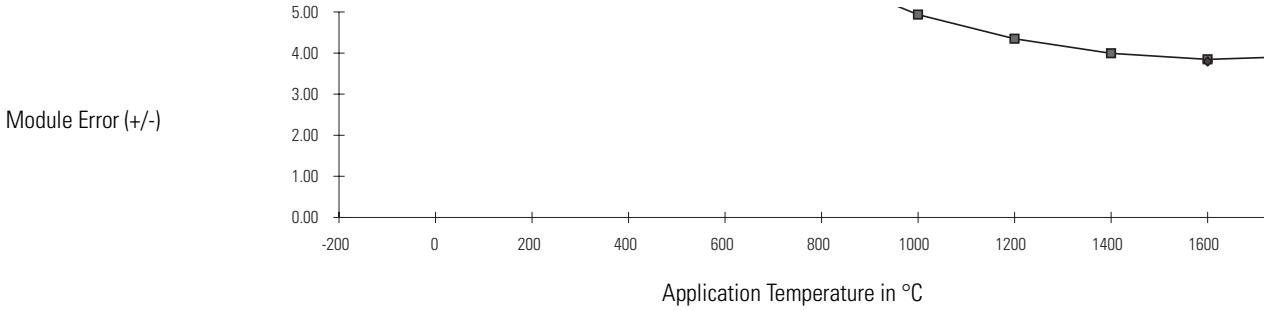


**Figure E.10 Thermocouple Module Error at 25° - Type R Thermocouple Connection in a -12 to 78mV Input Range**

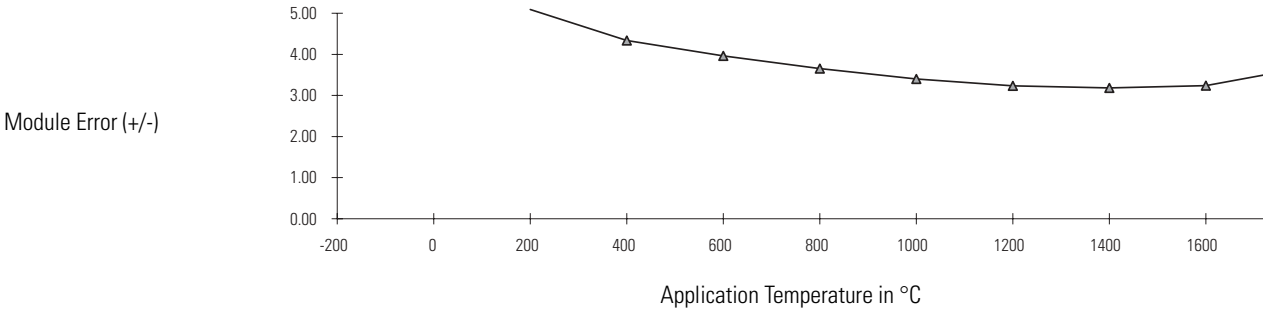



**Figure E.11 Thermocouple Module Error at 25° - Type S Thermocouple Connection in a -12 to 78mV Input Range**

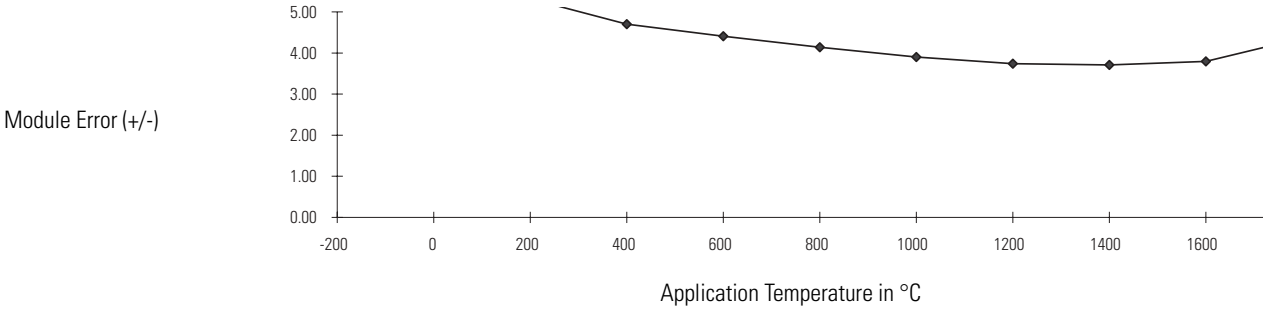



**Figure E.12 Thermocouple Module Error at 25° - Type E Thermocouple Connection in a -12 to 78mV Input Range**

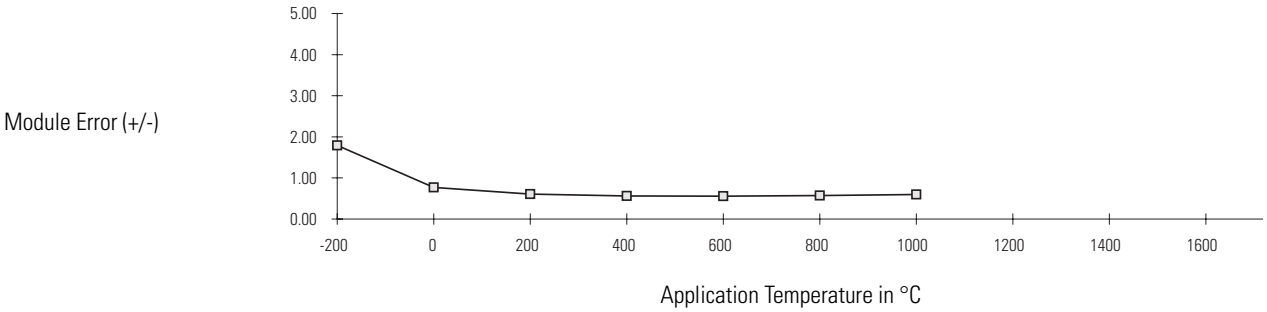


**Figure E.13 Thermocouple Module Error at 25° - Type J Thermocouple Connection in a -12 to 78mV Input Range**

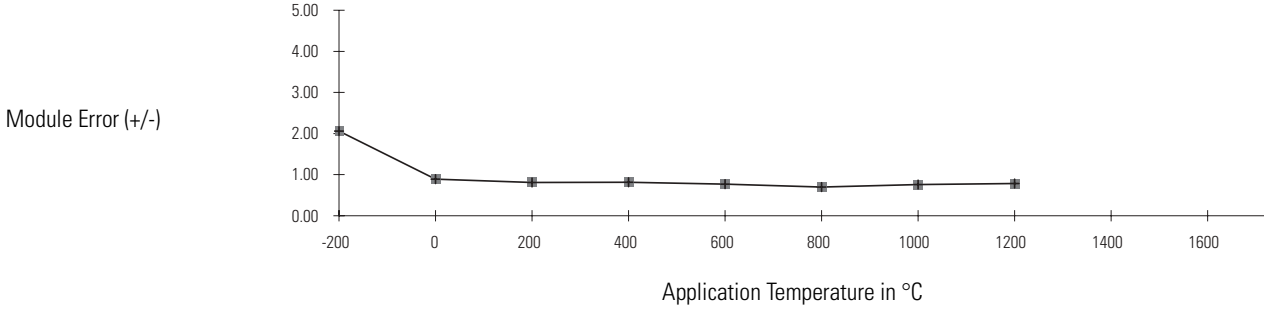



**Figure E.14 Thermocouple Module Error at 25° - Type K Thermocouple Connection in a -12 to 78mV Input Range**

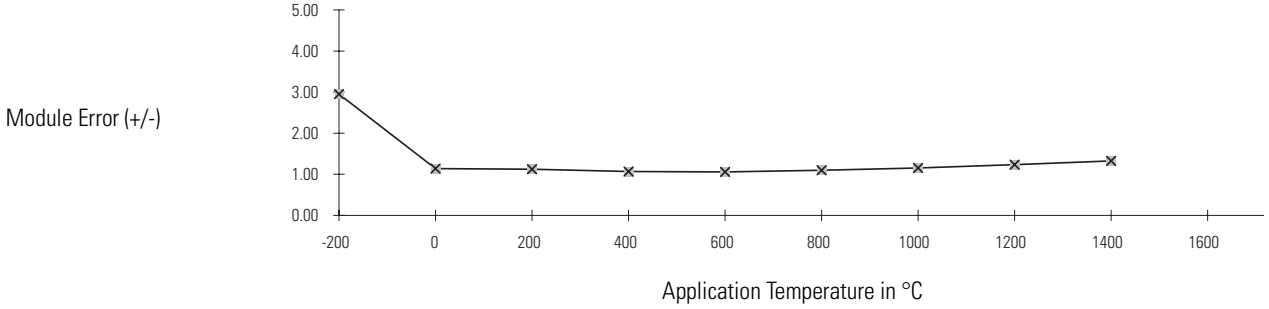



**Figure E.15 Thermocouple Module Error at 25° - Type N Thermocouple Connection in a -12 to 78mV Input Range**

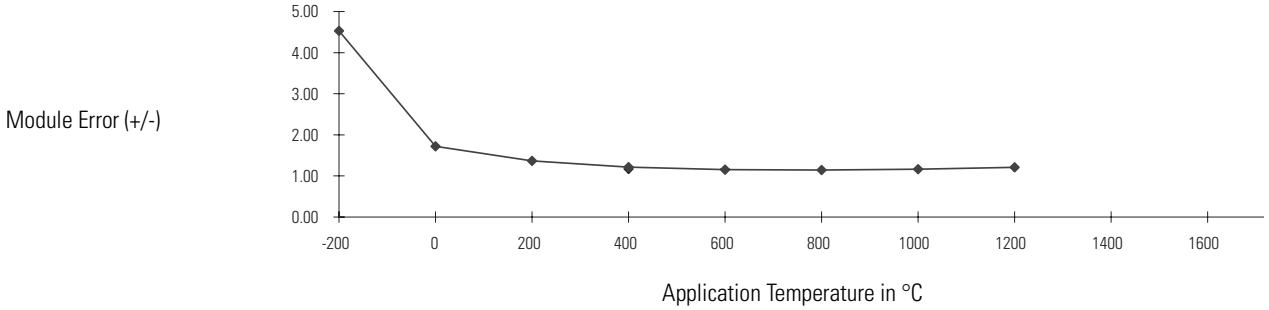
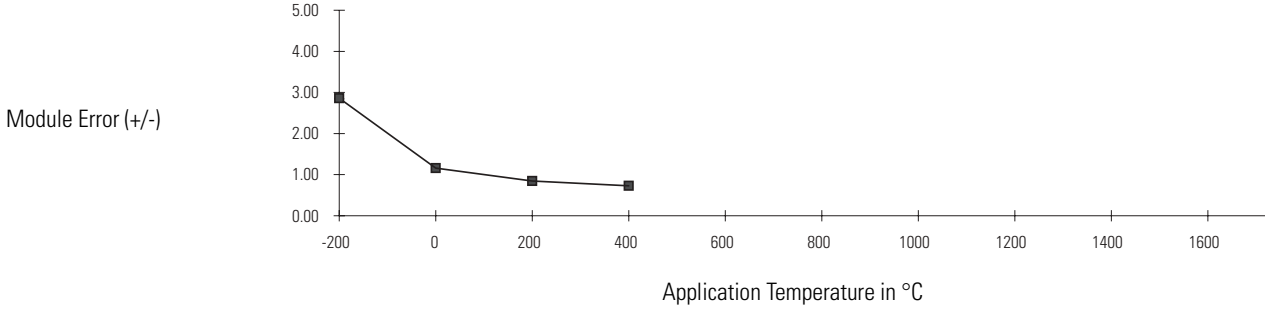


**Figure E.16 Thermocouple Module Error at 25° - Type T Thermocouple Connection in a -12 to 78mV Input Range**



## Thermocouple Resolution

Thermocouple resolution indicates the degrees that an application temperature must change before the ControlLogix thermocouple module reports a change. Resolution varies depending on the following factors:

- Input range used, either:
  - -12 to 30mV
  - -12 to 78mV
- Thermocouple type, any of the following:
  - B, R, S, E, J, K, N, T, L and D (L and D are used on the 1756-IT6I2 module only)
- Application temperature (i.e. the temperature of the physical location where the thermocouple is being used)

**EXAMPLE**

For example, when the 1756-IT6I module is operating in the following conditions:

- -12 to 30mV input range
- connected to a type K thermocouple
- application temperature of 400°C

the resolution is 0.017 degrees.

In other words, the application temperature must change by 0.017 degrees or greater for the 1756-IT6I module to record a change. If the temperature stays in a range from 399.984 to 400.0169°C, the module will continue to report an application temperature of 400°C.

## Module Resolution (-12 to 30mV Range)

Table E.3 lists the resolution of ControlLogix thermocouple modules when used in the -12 to 30mV input range.

**Table E.3**

| Application Temperature in °C: | Module Resolution (in degrees) When Connected to This Thermocouple Type: | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | B | R | S | E[1] | J[2] | K[3] | N[4] | T |
| -200°C | | | | 0.028 | 0.032 | 0.046 | 0.071 | 0.044 |
| 0°C | | 0.13 | 0.13 | 0.012 | 0.014 | 0.018 | 0.027 | 0.018 |
| 200°C | | 0.08 | 0.08 | 0.009 | 0.013 | 0.018 | 0.021 | 0.013 |
| 400°C | 0.17 | 0.07 | 0.07 | 0.009 | 0.013 | 0.017 | 0.019 | 0.011 |
| 600°C | 0.12 | 0.06 | 0.07 | | | 0.016 | 0.02 | |
| 800°C | 0.09 | 0.06 | 0.06 | | | | 0.02 | |
| 1000°C | 0.08 | 0.05 | 0.06 | | | | | |
| 1200°C | 0.07 | 0.05 | 0.06 | | | | | |
| 1400°C | 0.06 | 0.05 | 0.06 | | | | | |
| 1600°C | 0.06 | 0.05 | 0.06 | | | | | |
| 1800°C | 0.06 | 0.06 | 0.07 | | | | | |

(1) Type E thermocouples can only be used in applications up to 400°C.

(2) Type J thermocouples can only be used in applications up to 550°C.

(3) Type K thermocouples can only be used in applications up to 700°C.

(4) Type N thermocouples can only be used in applications up to 800°C.

The information represented in Table E.3 is shown graphically in Figure E.17 through Figure E.24.

**Figure E.17 Thermocouple Module Resolution - Type B Thermocouple Connection in a -12 to 30mV Input Range**

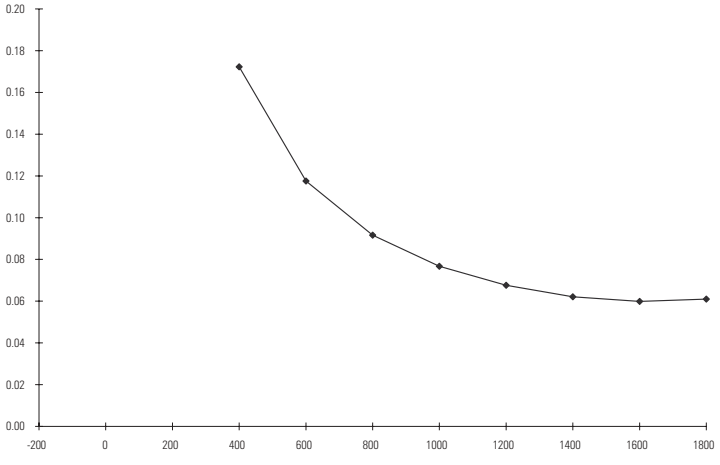


**Figure E.18 Thermocouple Module Resolution - Type R Thermocouple Connection in a -12 to 30mV Input Range**

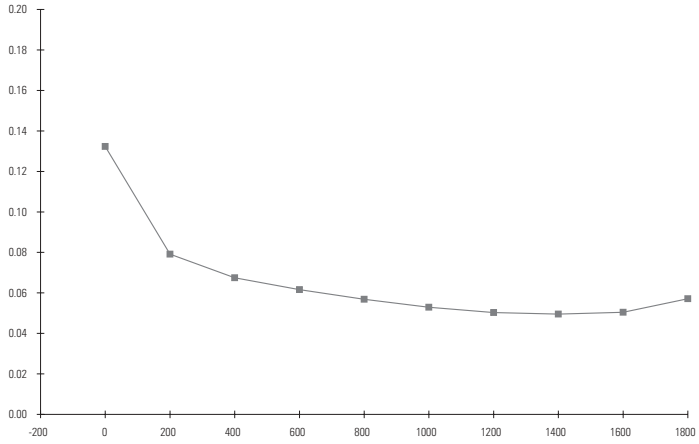



**Figure E.19 Thermocouple Module Resolution - Type S Thermocouple Connection in a -12 to 30mV Input Range**

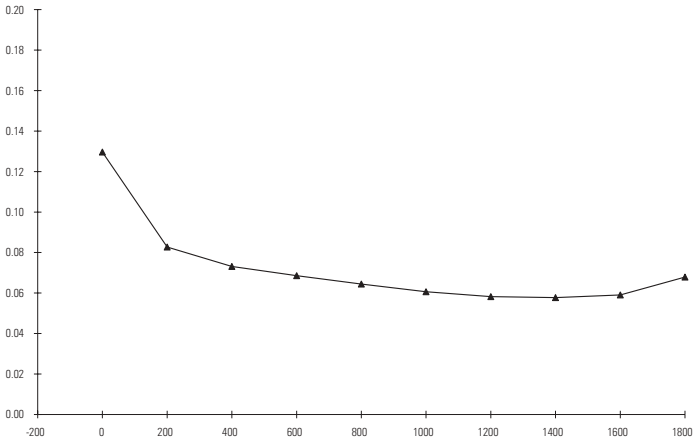



**Figure E.20 Thermocouple Module Resolution - Type E Thermocouple Connection in a -12 to 30mV Input Range**

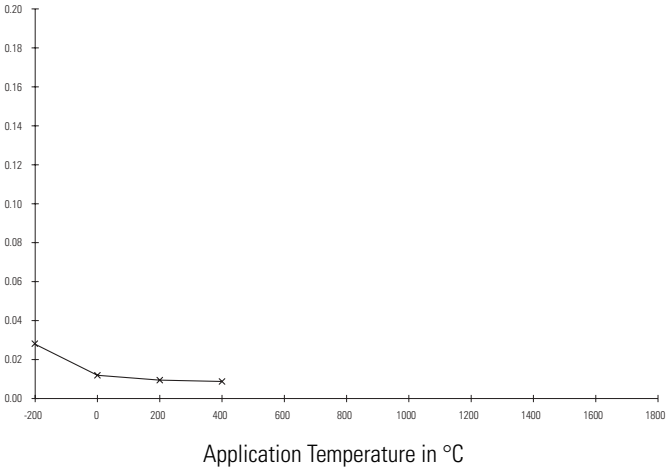


**Figure E.21 Thermocouple Module Resolution - Type J Thermocouple Connection in a -12 to 30mV Input Range**

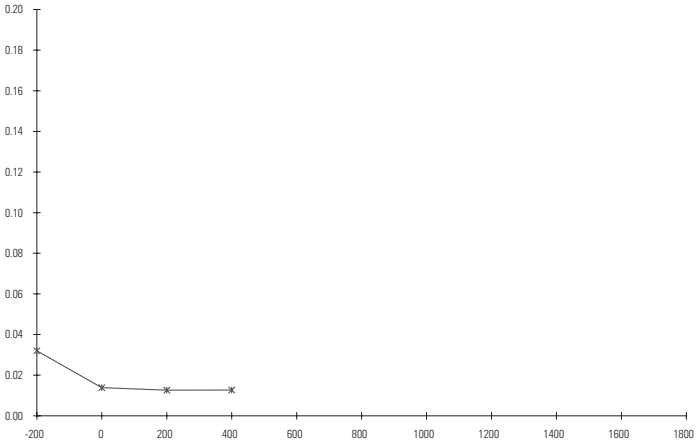



**Figure E.22 Thermocouple Module Resolution - Type K Thermocouple Connection in a -12 to 30mV Input Range**

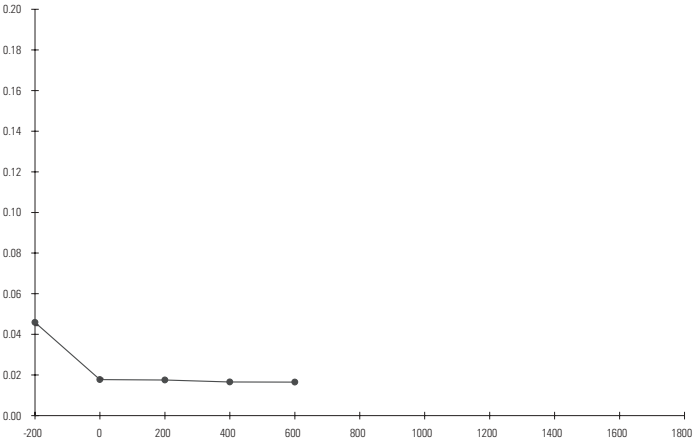



**Figure E.23 Thermocouple Module Resolution - Type N Thermocouple Connection in a -12 to 30mV Input Range**

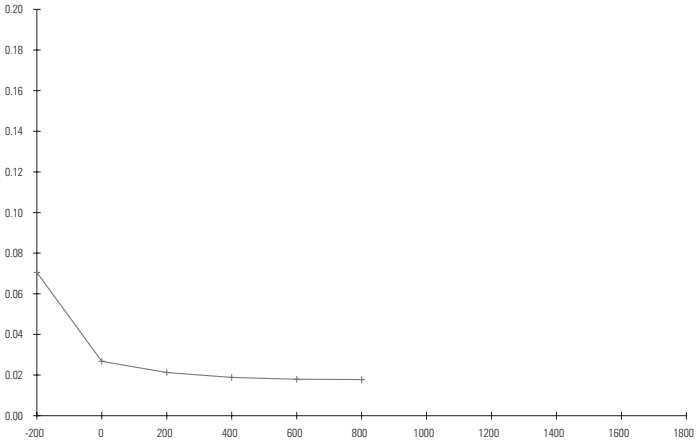
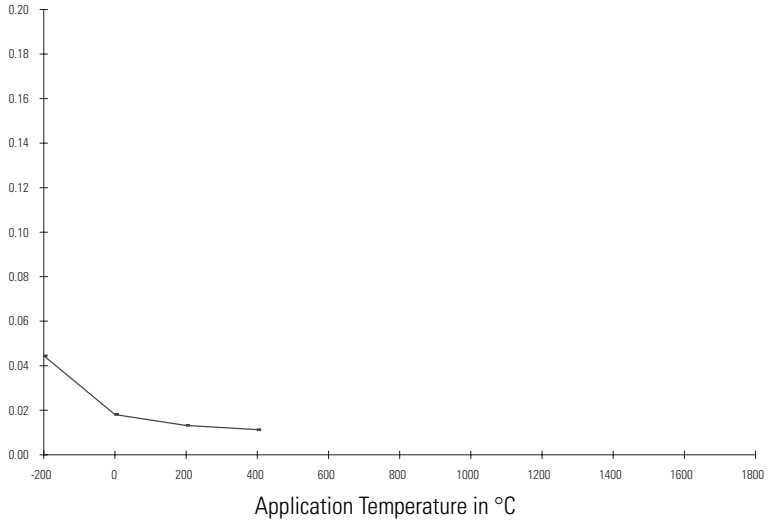


**Figure E.24 Thermocouple Module Resolution - Type T Thermocouple Connection in a -12 to 30mV Input Range**




## Module Resolution (-12 to 78mV Range)

Table E.4 lists the resolution of ControlLogix thermocouple modules when used in the -12 to 78mV input range.

**Table E.4**

| Application Temperature in °C: | Module Resolution (in degrees) When Connected to This Thermocouple Type: | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | **B** | **R** | **S** | **E** | **J** | **K** | **N** | **T** |
| -200°C (-328°F) | | | | 0.056 | 0.064 | 0.046 | 0.141 | 0.089 |
| 0°C (32°F) | | 0.26 | 0.26 | 0.024 | 0.028 | 0.092 | 0.054 | 0.036 |
| 200°C (392°F) | | 0.16 | 0.17 | 0.019 | 0.025 | 0.035 | 0.042 | 0.026 |
| 400°C (752°F) | 0.28 | 0.14 | 0.15 | 0.017 | 0.025 | 0.035 | 0.038 | 0.023 |
| 600°C (1112°F) | 0.23 | 0.12 | 0.14 | 0.017 | 0.024 | 0.033 | 0.04 | |
| 800°C (1472°F) | 0.18 | 0.11 | 0.13 | 0.018 | 0.022 | 0.033 | 0.04 | |
| 1000°C (1832°F) | 0.15 | 0.11 | 0.12 | 0.019 | 0.024 | 0.034 | 0.04 | |
| 1200°C (2192°F) | 0.14 | 0.10 | 0.12 | | 0.024 | 0.036 | 0.04 | |
| 1400°C (2552°F) | 0.12 | 0.10 | 0.12 | | | 0.038 | | |
| 1600°C (2912°F) | 0.12 | 0.10 | 0.12 | | | | | |
| 1800°C (3272°F) | 0.12 | 0.11 | 0.14 | | | | | |

The information represented in Table E.2 is shown graphically in Figure E.25 through Figure E.32.

**Figure E.25 Thermocouple Module Resolution - Type B Thermocouple Connection in a -12 to 78mV Input Range**

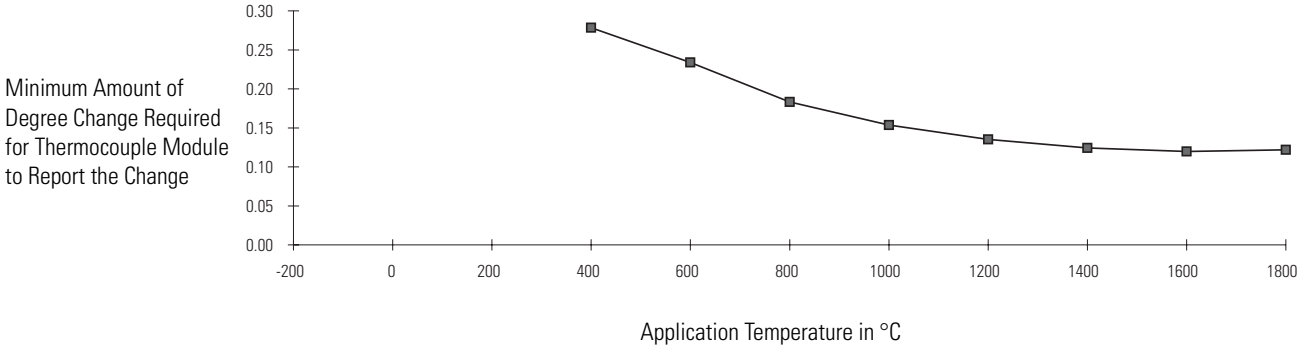



**Figure E.26 Thermocouple Module Resolution - Type R Thermocouple Connection in a -12 to 78mV Input Range**

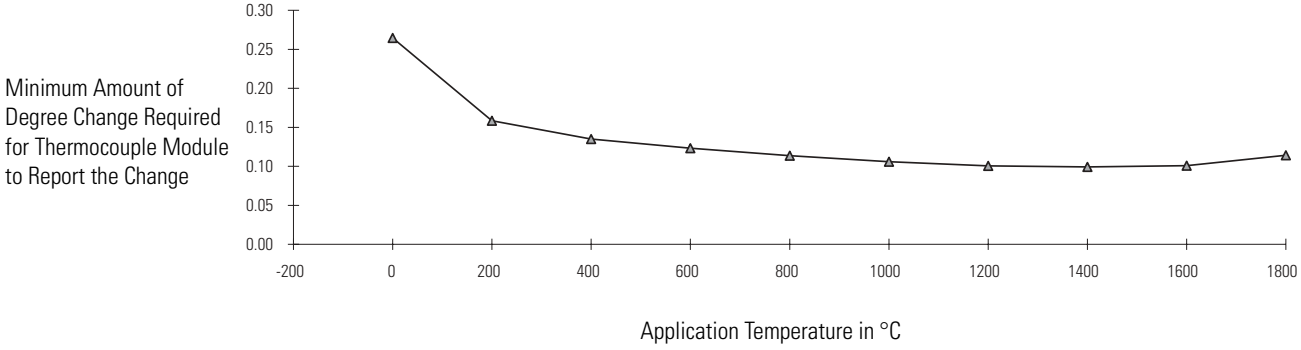



**Figure E.27 Thermocouple Module Resolution - Type S Thermocouple Connection in a -12 to 78mV Input Range**

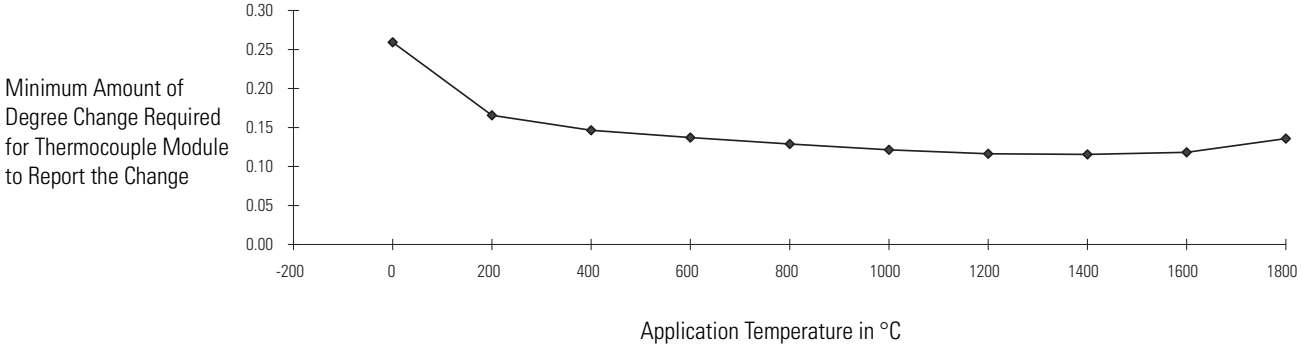


**Figure E.28 Thermocouple Module Resolution - Type E Thermocouple Connection in a -12 to 78mV Input Range**

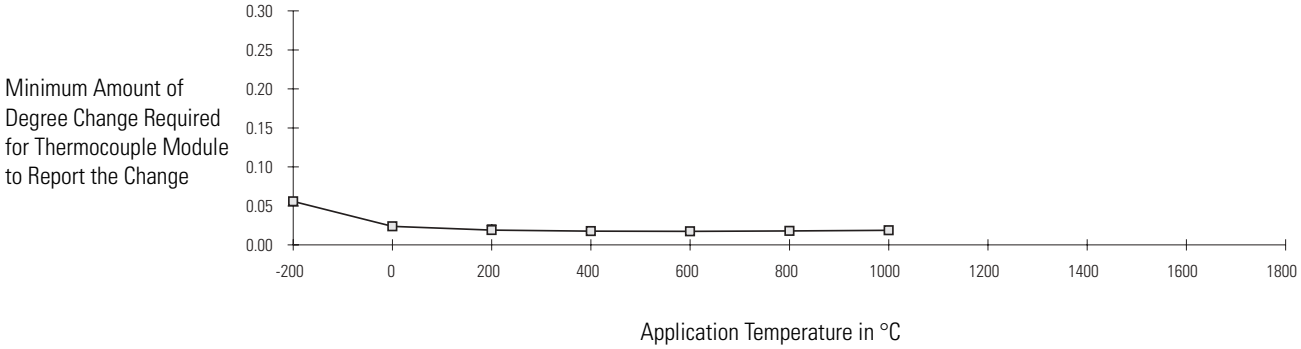



**Figure E.29 Thermocouple Module Resolution - Type J Thermocouple Connection in a -12 to 78mV Input Range**

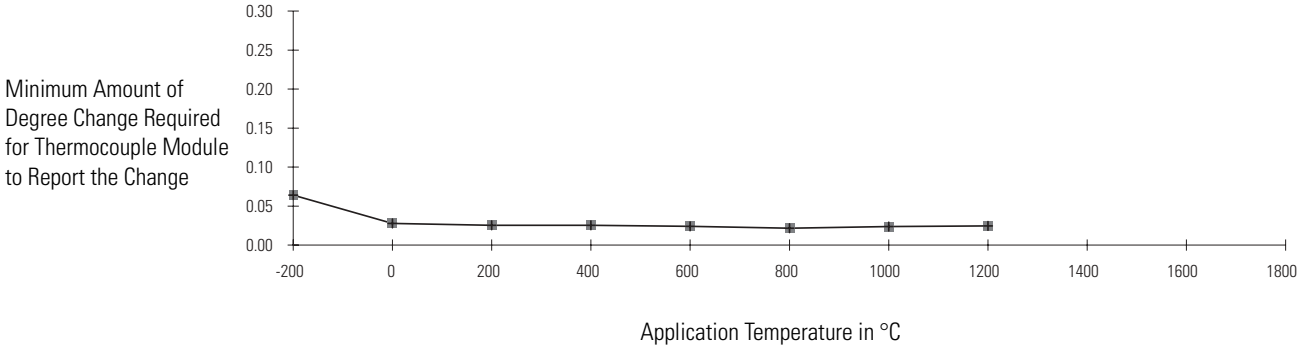



**Figure E.30 Thermocouple Module Resolution - Type K Thermocouple Connection in a -12 to 78mV Input Range**

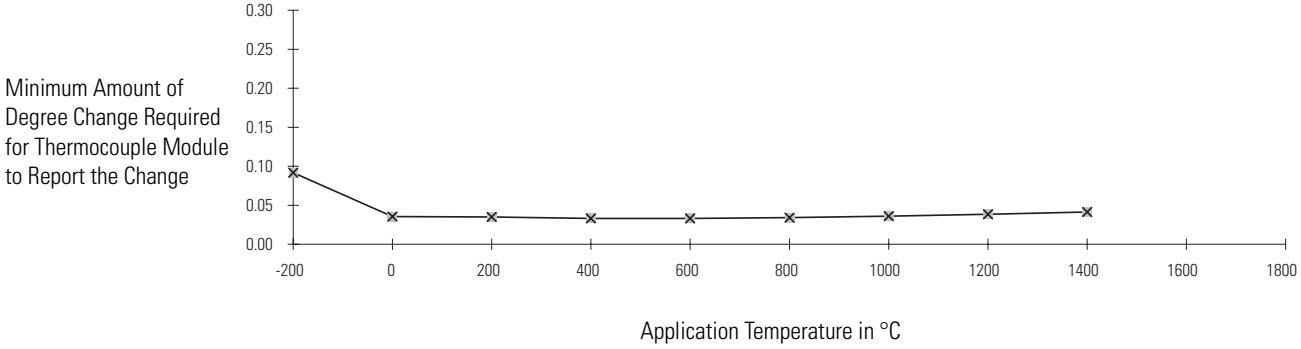


**Figure E.31 Thermocouple Module Resolution - Type N Thermocouple Connection in a -12 to 78mV Input Range**

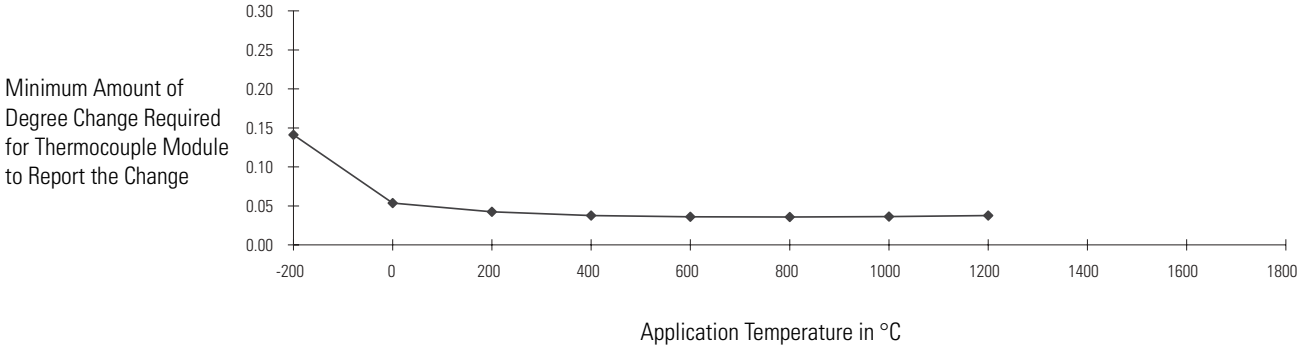
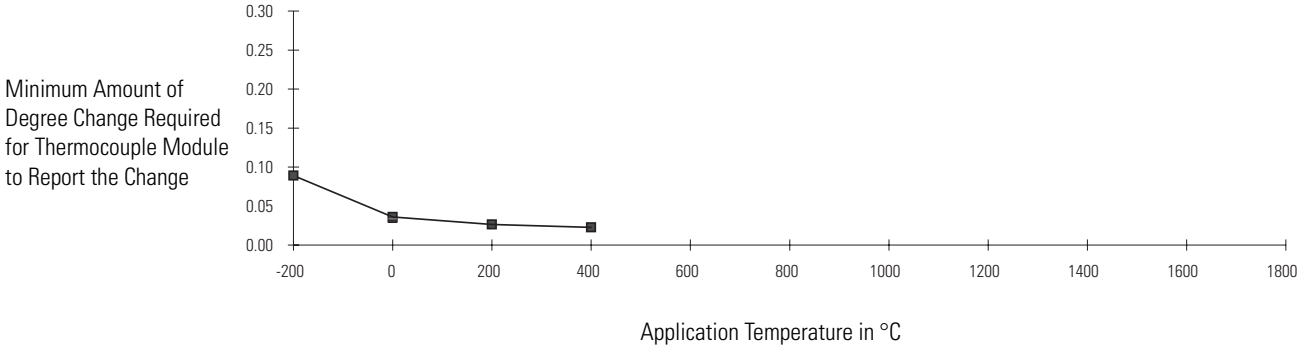



**Figure E.32 Thermocouple Module Resolution - Type T Thermocouple Connection in a -12 to 78mV Input Range**



## Notes:

# Using 1492 Wiring Systems with Your Analog I/O Module

As an alternative to buying RTBs and connecting the wires yourself, you can buy a wiring system of:

- **analog interface modules (AIFMs)** that mount on DIN rails provide the output terminal blocks for the I/O module. Use the AIFMs with the pre-wired cables that match the I/O module to the interface module.

  For a complete list of the AIFMs available for use with ControlLogix analog I/O modules, see Table F.2 on page F-3.

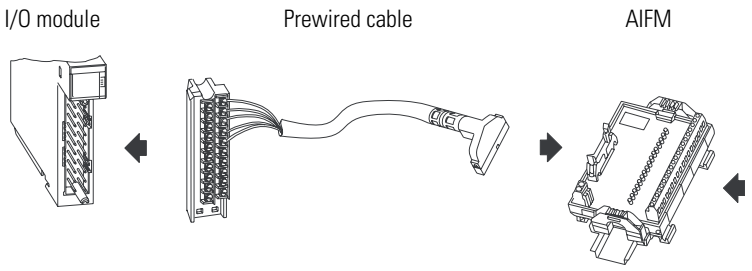
and

- **I/O-module-ready prewired cables**. One end of the cable assembly is an RTB that plugs into the front of the I/O module. The other end has individually color-coded conductors that connect to a standard terminal block.

  For a complete list of the prewired cables available for use with ControlLogix analog I/O modules, see Table F.3 on page F-3.

Figure F.1 shows the AIFM and prewired cables.

**Figure F.1**




**IMPORTANT** The 1492 IFMs may not be used in any application that requires agency certification of the ControlLogix system. Use of the IFM violates the UL, CSA and FM certifications of these products.

Table F.1 lists the AIFMs and prewired cables that can be used with specific ControlLogix analog I/O modules.

**Table F.1**

| For this module: | | Use this AIFM(s):[1] | With this prewired cable: |
|---|---|---|---|
| 1756-IF6CIS | | 1492-AIFM6S-3 | 1492-ACABLExX |
| 1756-IF6I | in current mode | 1492-AIFM6S-3 | 1492-ACABLExX |
| | in voltage mode | 1492-AIFM6S-3 | 1492-ACABLExY |
| 1756-IF8 | in single-ended current mode | 1492-AIFM8-3<br>1492-AIFM8-F-5 | 1492-ACABLExTB |
| | in single-ended voltage mode | 1492-AIFM8-3<br>1492-AIFM8-F-5 | 1492-ACABLExTA |
| | in differential current mode | 1492-AIFM8-3<br>1492-AIFM8-F-5 | 1492-ACABLExTD |
| | in differential voltage mode | 1492-AIFM8-3<br>1492-AIFM8-F-5 | 1492-ACABLExTC |
| 1756-IF16 | in single-ended current mode | 1492-AIFM8-3<br>1492-AIFM16-F-3<br>1492-AIFM16-F-5 | 1492-ACABLExUB |
| | in single-ended voltage mode | 1492-AIFM8-3<br>1492-AIFM16-F-3<br>1492-AIFM16-F-5 | 1492-ACABLExUA |
| | in differential current mode | 1492-AIFM8-3<br>1492-AIFM16-F-3<br>1492-AIFM16-F-5 | 1492-ACABLExUD |
| | in differential voltage mode | 1492-AIFM8-3<br>1492-AIFM16-F-3<br>1492-AIFM16-F-5 | 1492-ACABLExUC |
| 1756-IR6I | | 1492-AIFM6S-3 | 1492-ACABLExZ |
| 1756-IT6I | | 1492-AIFM6TC-3 | 1492-ACABLExY |
| 1756-IT6I2 | | 1492-AIFM6TC-3 | 1492-ACABLExYT |
| 1756-OF4 | in current mode | 1492-AIFM4-3 | 1492-ACABLExVB |
| | in voltage mode | 1492-AIFM4-3 | 1492-ACABLExVA |
| 1756-OF6CI | | 1492-AIFM6S-3 | 1492-ACABLExY |
| 1756-OF6VI | | 1492-AIFM6S-3 | 1492-ACABLExY |
| 1756-OF8 | in current mode | 1492-AIFM8-3 | 1492-ACABLExWB |
| | in voltage mode | 1492-AIFM8-3 | 1492-ACABLExWA |

[1] When multiple AIFMs are listed for a catalog number, both fit the application listed. For example, when using the 1756-IF8 in single-ended current mode, you can use either the 1492-AIFM8-3 or 1492-AIFM8-F-5.

Table F.2 describes the AIFMs available for use with your ControlLogix analog I/O modules.

**Table F.2**

| Catalog Number | Type of AIFM: | Description: |
|---|---|---|
| 1492-AIFM4-3 | feed through | 4 channels with 3 terminals per channel |
| 1492-AIFM6S-3 | feed through | 6 channels isolated with 3-4 terminals per channel |
| 1492-AIFM8-3 | feed through | 8 channels with 3 terminals per channel |
| 1492-AIFM6TC-3 | thermocouple | 6 channels with 3 terminals per channel |
| 1492-AIFM8-F-5 | fusible | 8 channels with 5 terminals per channel |
| 1492-AIFM16-F-3 | fusible | 16 channels with 3 terminals per channel |
| 1492-AIFM16-F-5 | fusible | 16 channels with 5 terminals per channel |

Table F.3 describes the I/O module-ready prewired cables available for use with your ControlLogix analog I/O modules.

**Table F.3 t**

| Catalog Number:(1) | Number of Conductors:(2) | Conductor Size: | Nominal Outer Diameter: | RTB at the I/O Module End: |
|---|---|---|---|---|
| 1492-ACABlExM | 11 twisted pairs | 22 AWG | 11.5 mm (0.45 in) | 1757-PIM |
| 1492-ACABLExX | 9 twisted pairs(3) | 22 AWG | 6.8 mm (0.27 in) | 1756-TBNH |
| 1492-ACABLExY | 9 twisted pairs(4) | 22 AWG | 6.8 mm (0.27 in) | 1756-TBNH |
| 1492-ACABLExZ | 20 conductors(5) | 22 AWG | 8.4 mm (0.33 in) | 1756-TBNH |
| 1492-ACABLExTA | 20 conductors | 22 AWG | 8.4 mm (0.33 in) | 1756-TBCH |
| 1492-ACABLExTB | 20 conductors | 22 AWG | 8.4 mm (0.33 in) | 1756-TBCH |
| 1492-ACABLExTC | 5 twisted pairs | 22 AWG | 8.4 mm (0.33 in) | 1756-TBCH |
| 1492-ACABLExTD | 5 twisted pairs | 22 AWG | 8.4 mm (0.33 in) | 1756-TBCH |
| 1492-ACABLExUA | 20 conductors | 22 AWG | 8.4 mm (0.33 in) | 1756-TBCH |
| 1492-ACABLExUB | 20 conductors | 22 AWG | 8.4 mm (0.33 in) | 1756-TBCH |
| 1492-ACABLExUC | 9 twisted pairs | 22 AWG | 6.8 mm (0.27 in) | 1756-TBCH |
| 1492-ACABLExUD | 9 twisted pairs | 22 AWG | 6.8 mm (0.27 in) | 1756-TBCH |
| 1492-ACABLExVA | 20 conductors | 22 AWG | 8.4 mm (0.33 in) | 1756-TBNH |
| 1492-ACABLExVB | 20 conductors | 22 AWG | 8.4 mm (0.33 in) | 1756-TBNH |
| 1492-ACABLExWA | 9 twisted pairs | 22 AWG | 6.8 mm (0.27 in) | 1756-TBNH |
| 1492-ACABLExWB | 9 twisted pairs | 22 AWG | 6.8 mm (0.27 in) | 1756-TBNH |

(1) Cables are available in lengths of 0.5m, 1.0m, 2.5m, and 5.0m. To order, insert the code for the desired cable length into the catalog number in place of the x: 005=0.5m, 010=1.0m, 25=2.5m, 050=5m. Build-to-order cable lengths are also available.

(2) Each cable for analog I/O has an overall shield with a ring lug on a 200mm (8.87 in) exposed drain wire at the I/O module end of the cable.

(3) One pair is not connected to the I/O module connector; two additional pairs are not used.

(4) Two pairs are not used.

(5) One conductor is not connected to the I/O module connector; one additional conductor is not used.

## Notes:

**Broadcast**

Data transmissions to all addresses

**Communications format**

Format that defines the type of information transferred between an I/O module and its owner-controller. This format also defines the tags created for each I/O module.

On the 1756-IF16 and 1756-IF8 modules, the communications format must match module wiring.

**Compatible match**

An electronic keying protection mode that requires the physical module and the module configured in the software to match according to vendor, catalog number and major revision. In this case, the minor revision of the module must be greater than or equal to that of the configured slot.

**Connection**

The continuous communication mechanism from the controller to an I/O module in the control system

**ControlBus**

The backplane used by the 1756 chassis

**Coordinated System Time (CST)**

Timer value which is kept synchronized for all modules within a single ControlBus chassis. The CST is a 64-bit number with microsecond resolution.

**Direct Connection**

An I/O connection where the controller establishes an individual connection with I/O modules

**Disable keying**

An option that turns off all electronic keying to the module. Requires no attributes of the physical module and the module configured in the software to match.

**Download**

The process of transferring the contents of a project on the workstation into the controller

**Electronic keying**

A system feature which makes sure that the physical module attributes are consistent with what was configured in the software

**Exact match**

An electronic keying protection mode that requires the physical module and the module configured in the software to match identically, according to vendor, catalog number, major revision and minor revision

**Field side**

Interface between user field wiring and I/O module

**Inhibit**

A ControlLogix process that allows you to configure an I/O module but prevent it from communicating with the owner-controller. In this case, the controller does not establish a connection

**Interface module (IFM)**

A prewired removable terminal block (RTB)

**Listen-only connection**

An I/O connection that allows a controller to monitor I/O module data without owning the module

**Major revision**

A module revision that is updated any time there is a functional change to the module resulting in an interface change with software

**Minor revision**

A module revision that is updated any time there is a change to the module that does not affect its function or software user interface (e.g. bug fix)

**Multicast**

Data transmissions which reach a specific group of one or more destinations

**Multiple owners**

A configuration set-up where multiple owner-controllers use exactly the same configuration information to simultaneously own an input module

**Network update time (NUT)**

The smallest repetitive time interval in which the data can be sent on a ControlNet network. The NUT may be configured over the range from 2ms to 100ms using RSNetWorx

**Owner-controller**

The controller that creates and stores the primary configuration and communication connection to a module

**Program mode**

In this mode, the controller program is not executing. Inputs are actively producing data. Outputs are not actively controlled and go to their configured program mode state.

**Remote connection**

An I/O connection where the controller establishes an individual connection with I/O modules in a remote chassis

**Removable terminal block (RTB)**

Field wiring connector for I/O modules

**Removal and insertion under power (RIUP)**

ControlLogix feature that allows a user to install or remove a module or RTB while power is applied

**Requested packet interval (RPI)**

A configurable parameter which defines when the module will multicast data

**Run mode**

In this mode, the controller program is executing. Inputs are actively producing data. Outputs are actively controlled.

**Service**

A system feature that is performed on user demand

**System side**

Backplane side of the interface to the I/O module

**Tag**

A named area of the controller's memory where data is stored like a variable

**Timestamping**

ControlLogix process that stamps a change in input, output, or diagnostic data with a time reference indicating when that change occurred

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**Corporate Headquarters**
Rockwell Automation, 777 East Wisconsin Avenue, Suite 1400, Milwaukee, WI, 53202-5302 USA, Tel: (1) 414.212.5200, Fax: (1) 414.212.5201

**Headquarters for Allen-Bradley Products, Rockwell Software Products and Global Manufacturing Solutions**
Americas: Rockwell Automation, 1201 South Second Street, Milwaukee, WI 53204-2496 USA, Tel: (1) 414.382.2000, Fax: (1) 414.382.4444
Europe: Rockwell Automation SA/NV, Vorstlaan/Boulevard du Souverain 36-BP 3A/B, 1170 Brussels, Belgium, Tel: (32) 2 663 0600, Fax: (32) 2 663 0640
Asia Pacific: Rockwell Automation, 27/F Citicorp Centre, 18 Whitfield Road, Causeway Bay, Hong Kong, Tel: (852) 2887 4788, Fax: (852) 2508 1846

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Europe: Rockwell Automation, Brühlstraße 22, D-74834 Elztal-Dallau, Germany, Tel: (49) 6261 9410, Fax: (49) 6261 17741
Asia Pacific: Rockwell Automation, 55 Newton Road, #11-01/02 Revenue House, Singapore 307987, Tel: (65) 351 6723, Fax: (65) 355 1733

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